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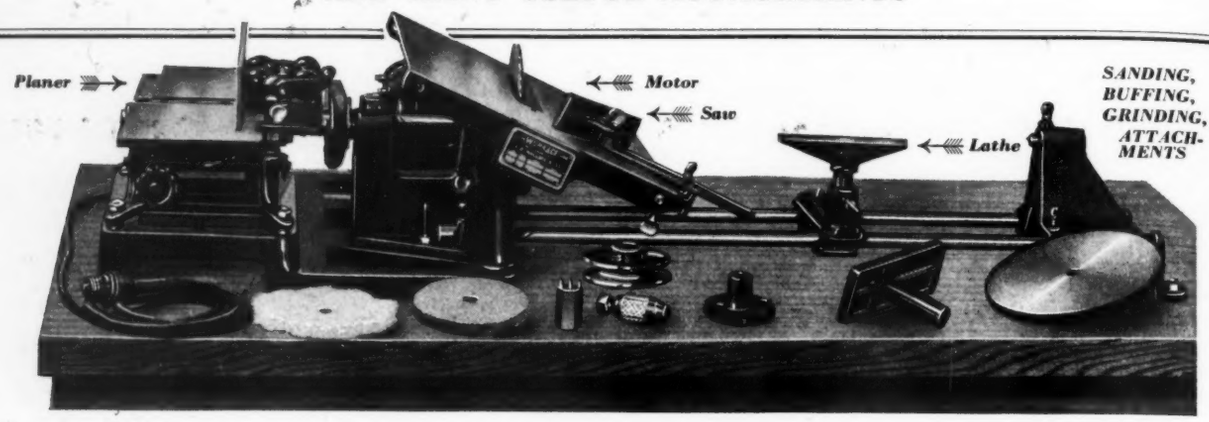

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WHAT IS NEW THIS MONTH

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NEXT MONTH—Fascinating articles that will tell of the latest achievements of invention and discovery; also practical how-to-make-it features for home workshop, radio, housebuilding and automobile enthusiasts

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April 1, 1927	10%	3%	13%	20.00
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July 2, 1928 (3 mos.)	4%	(annual rate 16%)		28.25

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A *Shoe-string* Adventure *in the* Stock Market

By WALLACE AMES, *Financial Editor*

CHAPTER I

"WELL, boys, I'm all set for a killing," announced Howard Bullard, as he and three cronies sat down and began to deal the cards for their weekly bridge session.

"Don't be too sure," suggested John Snyder. "I seem to remember that you were the big loser last week."

"I wasn't speaking of winning at bridge, although there is no one in this bunch to worry me," retorted Howard. "I was just enlightening you. I am going to clean up some of this easy money in the stock market that I hear so much about."

Andy Dyer joined in. "Every one I meet these days is dabbling in stocks and if they are making one-tenth the money they talk about they'll all be sailing to the Riviera in their private yachts this winter. I've been thinking of taking a flier myself."

"What did you buy, Howard?" inquired Bob Stoddard, the fourth member of the group.

"I didn't buy anything yet," explained Bullard. "Just made up my mind today to try my luck. I'm going to open an account tomorrow."

"Stop by and pick me up," suggested Dyer. "I have a couple of thousand in the bank. I'll go down to the broker's office with you and get rich too."

"Umph!" grunted Bob. "Guess I'll tip off my friends to sell short. When you two start speculating in stocks it is the best sign that I know that the market is going to break."

"Hey!" broke in John Snyder, "did we get together to play bridge or to listen to you fellows razz each other?"

CHAPTER II

"What you going to buy?" asked Andy as he and Howard started for the broker's office at noon hour the next day.

"Guess I'll take a flier in Wright Aero," said Howard. "I've been watching that stock. Only a few days ago it was selling below 100. It has been going up to beat the band, sometimes ten and twenty points a day. It's over 200 now; wouldn't surprise me if it sold over 1000."

"Not for me," remarked Andy. "You want to make money too fast. I read in last night's paper about the merger of Chrysler and Dodge. I'm going to buy Chrysler and be satisfied with 50 points profit."

Howard Bullard bought 50 shares of Wright Aero at 230 on margin, putting up $2,500 and Andy used his $2,000 to margin 100 shares of Chrysler which he got at 83. And thus ends Chapter II.

CHAPTER III

"What did Wright Aero do today?" inquired Bob Stoddard when the bunch got together a few nights later.

"Plenty," was the laconic reply of Howard Bullard. "I was cleaned out today."

"That's tough. How's your Chrysler?" asked Bob, turning to Andy.

"Great! After the merger was announced in the newspapers I guess all the 'insiders' began to sell, and one of them sold to me. The stock dropped 15 points from the price I paid. I just sent the broker another $1,000 margin. If the stock ever gets back to near what I paid for it I am going to get out. Otherwise I'm cleaned too."

"Are we going to play bridge or aren't we?" asked John Snyder.

CHAPTER IV

"Things were a little quiet at the office this morning," said Bob Stoddard, when the trio met for lunch next day, "so I made up some figures I want to show you fellows.

"In spite of the joshing and razzing that takes place whenever our bunch gets together we are good friends and it is in the spirit of real friendliness that I am going to show you what I have done in the way of investing. I never talked about it before because you chaps knew so much before you got burned in the market that you would only have laughed at me.

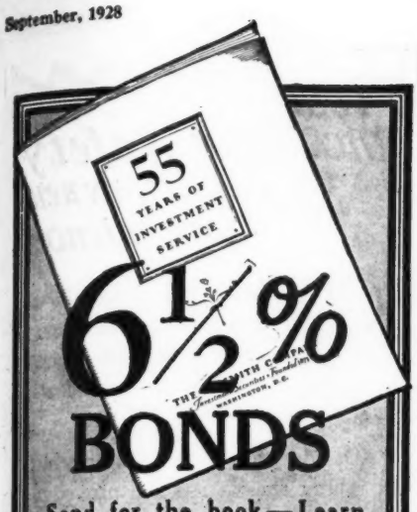
"While you have been losing money in the market I have been making it. And making a lot of it too. Five years ago I invested $1,368 in fifteen different stocks, one share of each. I did not buy on margin, but outright.

"All I knew about Wall Street was that if I went in on a shoe-string for a quick turn I'd get it—the wrong way. But we had just gone through a few years of depression and the prices of even the best securities were low. When I bought stocks I planned to hold them several years if necessary. I would receive dividends from most of them and maybe some day I could sell part or all of my holdings at a substantial profit.

"For the past five years I have sat on the sidelines with my stocks and watched the circus. Three years ago I began to notice that people of my own acquaintance, who seldom dabble in the market, were getting interested. Two years ago this public interest was greater, during the last year still greater, and during the first half of this year it was intense.

"I began to notice that friends, like you two, were plunging headlong without rhyme or reason. Although I was partly joking the other night when I said it was time to sell if you fellows were going to take a flier I got thinking it over after the game broke up and decided that it was time to cash in my profit.

"So when you were (*Continued on page 5*)



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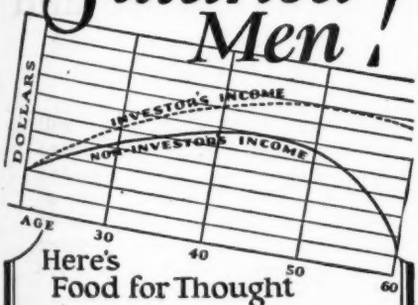

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M 469

A *Shoe-string* Adventure *in the* Stock Market

(*Continued from page 4*)

going like lambs to the slaughter I called up my broker and sold out my stocks. My $1,368 investment brought me $5,742 or a profit of $4,374 in addition to the dividends I have received during the past five years.

"When some of the stocks I bought went way up in price they were split up, several new shares being given in exchange for one of the old. Others gave stock dividends in addition to cash dividends. So, whereas I originally bought one share of each stock, I later owned anywhere from two to ten shares of some of them.

"Here is the list of what I bought in 1923, what I paid, what I sold for and what I made on each transaction." Then Bob produced the following memorandum:

	Price Paid in 1923	Price Received in 1928	Gain
Atchison	$100	187	$ 87
C. & O.	66	182	116
N. Y. Central	95	173	78
Pere Marquette	42	133	91
Texas & Pacific	22	128	126
5 Rails	**325**	**803**	**478**
Am. Power & Light	160	770	610
Am. Tel. & Tel.	125	179	54
Am. Water Wks.	36	570	534
Consol. Gas	63	146	83
Pacific Gas & Elec.	89	188	99
5 Utilities	**473**	**1853**	**1380**
Am. Bank Note	89	550	461
American Can	90	520	430
du Pont	127	1020	893
Gen. Electric	185	584	399
Sears Roebuck	79	412	333
5 Industrials	**570**	**3086**	**2516**
5 Railroads	325	803	478
5 Utilities	473	1853	1380
5 Industrials	570	3086	2516
15 Stocks	**1368**	**5742**	**4374**

"Recently I read a news item about automobile stocks. It showed what $100 invested five years ago would have paid in dividends and increased market value. Between January 2, 1923 and June 15, 1928 $100 invested in General Motors would have amounted to $1,034, in Packard, $1,002, in Nash, $939, in Hudson, $469, in Studebaker, $200 and in Chrysler, $1,977.

$1,977 in Chrysler! ejaculated Andy Dyer. Impossible! Why, I stand to lose $2000 in that stock."

"Yes," explained Bob, "but you and I are talking about two entirely different kinds of transactions. You bought on margin, blindly, at the recent high price created by wild speculation. You were gambling for a quick turn. The market broke and you now have your last cent tied up. If it goes lower and you can't raise more margin you will be closed out as Howard was. If you had bought outright you would not have been hurt by the decline and the chances are that some time hence you could sell at a profit, even above the high price you paid.

"Believe me, boys, there is nothing in this shoe-string business for us. Divide your money between good bonds and good stocks. Once in a while you may cash in a big profit on some of your stocks, but you'll never do anything but 'feed the kitty' when you try for a quick turn.

"What are you doing with your money now?" Howard Bullard asked Bob.

"It is tucked away (*Continued on page 6*)

Retire *in 15 years*

on your Present *living Budget*

by investing in safe First Mortgage Bonds

Follow the definite plan given in this book, and your financial independence is won.

The plan works just as surely, whether you are now earning $1,000 or $100,000 a year.

The way is certain—each step plainly indicated and absolutely safe—independent of luck, business genius or speculation.

Every fact has been harvested out of the 47 years' experience of Cochran & McCluer in the first mortgage investment banking business.

The plan is so simple, anyone can understand it—so definite anyone can follow it—and so certain, no one can fail.

In addition to the Financial Independence Plan and the unique budget schedule, the book gives suggestions that enable you to enjoy more of the good things of life, both while building your independent fortune and after you have attained it.

We invite the most skeptical to read this plain, straightforward, interesting book.

Send coupon. We employ no salesmen, therefore none will call.

Mail this

P. S. M.-9-28

Cochran & McCluer Co.
46 N. Dearborn St., Chicago, Ill.

Please send me, without obligation, your book, "How To Retire In 15 Years."

Name.....

Street.....

City.....*State*.....

Cochran & McCluer Co.

Established 1881—Never a loss to any investor.

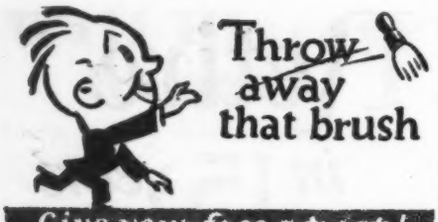
46 North Dearborn Street,
CHICAGO

How to Work with Tools and Wood

This book explains in a simple, straightforward manner all the processes of working with tools and wood. It takes all the mystery out of using tools and enables you to spend many interesting and profitable hours in your home workshop. All details are clearly explained.

Price $1.00

Popular Science Monthly
250 Fourth Avenue
New York City

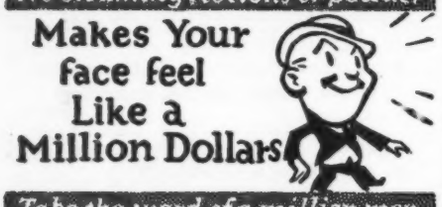


Give your face a treat!

No brush-no lather-no rubbing

Without danger of cutting skin

No steaming, lotions or powder



Take the word of a million men

Try MOLLÉ (MŌ-LAY) for a week at our expense!

MOLLÉ
·MŌ·LAY·
For Shaving Tough Beards and Tender Skins Without Brush or Lather
MADE SOLELY BY THE MOLLE CO. CLEVELAND, O. U.S.A.

See why a million men have switched, permanently, to MOLLÉ. Find out what we mean when we say MOLLÉ *lubricates the shave* with a protective film of healing creams, so you can shave faster than ever before, but without danger of cutting the skin.

Above all, we want you to know how wonderful MOLLÉ makes your face feel AFTER shaving. That "million-dollar" feeling simply can't be described.

Every MOLLÉ Shave is, in reality, a *facial treatment*—as refreshing and stimulating as a head-barber's facial massage.

The MOLLÉ Company
Cleveland, Ohio

Mail Coupon Today—7 MOLLÉ SHAVES FREE!

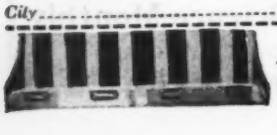
THE MOLLÉ COMPANY
Dept. 64, Cleveland, Ohio

Please send free and postage paid a week of MOLLÉ Shaves, to

*Name*_____

*St. Address*_____

*City*_____ *State*_____



A Whale of a Tube, 50c—at your Druggist

A *Shoe-string* Adventure *in the* Stock Market

(*Continued from page 5*)

in safe bonds. When prices are lower I shall probably buy some stocks again, but whenever I do it will be for the long pull, and I will always fortify myself with a substantial proportion of my little nest egg in sound bonds.

"Investments in real estate mortgage bonds, public utility issues and shares of investment trusts and other good, home-spun investments will get you ahead surely, which is better than trying to get rich quick and not getting ahead at all."

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"Ideal Investments" is the designation universally accorded Smith First Mortgage 6½% Bonds which carry attractive tax refund features. A history of the House and information relative to their bonds and the safeguards that surround every issue they offer may be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

"The Investment Trust from the Investor's Viewpoint," presents an explanation of this form of investment in easily understood terms, illustrated with some interesting examples of how the general investment trust will help the man with $100 or more to get ahead. Published for free distribution by United States Fiscal Corporation, 50 Broadway, New York. Ask them for Booklet IT.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

The Making of a Good Investment tells how 6¼% can be made on investment in First Mortgage Bonds in units of $50, $100, $250, $500 and $1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.

First *mortgage Safety with many new Conveniences*

GUARANTEED United First Mortgage Bonds offer you the safety of a well-secured first mortgage—without any collection or supervision worries.

Decide now to find out more about these tried and proven investment bonds—how they may be purchased out of income—how they will help you reach your financial goal.

Write for further information today.

UNITED STATES MORTGAGE BOND COMPANY
Howard C. Wade, President
365 U. S. Mortgage Building
Detroit, Michigan
Resources more than $20,000,000
In Canada: United Bond Co., Ltd., Toronto and Windsor, Ont.

6% GUARANTEED UNITED FIRST MORTGAGE BONDS

Don't fumble and grumble

AN EVEREADY Flashlight will spot a screw-slot in the dark so that a near-sighted man couldn't miss it! Great for little jobs of careful adjustment. And takes half the grief out of any other tedious, time-wasting work that's got to be done in the dark.

An Eveready Flashlight will set you right with the flashlight habit. That implies that you know your batteries, too, and always load your flashlights with genuine Eveready Batteries. Experience will prove that you can't beat 'em. They hold an extra share of endurance that keeps them coming through with plenty of light long after the ordinary kind are in the scrap pile. Loaded to the top with usefulness, they are, and when you reload a flashlight remember that. Get genuine Eveready Batteries always.

A definite program for getting ahead financially will be found on page four of this issue

GASOLINE + ETHYL = *high compression performance*

YOU are hearing much about "high compression"..."high compression engines"..."high compression fuel"..."high compression performance."

"What," a great many car owners are asking, "does 'high compression' mean to me?" Here is a simple explanation:

Each cylinder of your engine may be likened to a muzzle-loading gun. The cylinder is the gun; the piston is the bullet; and the mixture of gasoline and air is the powder charge.

The tighter you pack the powder charge in the gun before firing, the greater the force to the bullet. Similarly, the tighter you squeeze—or compress—gas vapor and air in the combustion chamber before ignition, the greater the force of the piston's stroke. In other words, the higher the compression the greater the power.

Higher compression in a gasoline engine is obtained by decreasing the size of the combustion chamber—either by mechanical design or by carbon formation.

Up to the advent of Ethyl Gasoline, the compression of automobile engines was limited by the compression limits of gasoline. For gasoline is not a perfect fuel. It explodes too soon ("knocks") and loses power when squeezed beyond a certain point.

That is why General Motors Research Laboratories developed ETHYL fluid, a compound which controls the combustion rate of gasoline so that as engine compression is raised the "knock" is eliminated. And that is why oil companies are mixing ETHYL fluid with gasoline to form *Ethyl Gasoline*—the standard high compression fuel.

Within the last year, car manufacturers have been able to produce new models of higher compression and greater power. ***But the most immediate benefits of Ethyl Gasoline are found among the millions of owners of cars of ordinary compression, because with its use in such cars carbon becomes an asset.***

ETHYL
BRAND OF ANTI-KNOCK COMPOUND
ETHYL GASOLINE CORPORATION
NEW YORK, U.S.A.
Knocks out that knock

Ride with ETHYL. See what a great difference it makes on hills and in traffic. No "knocking." Less shifting. Faster pickup. Stop at an ETHYL pump today—it bears the emblem shown at the left.

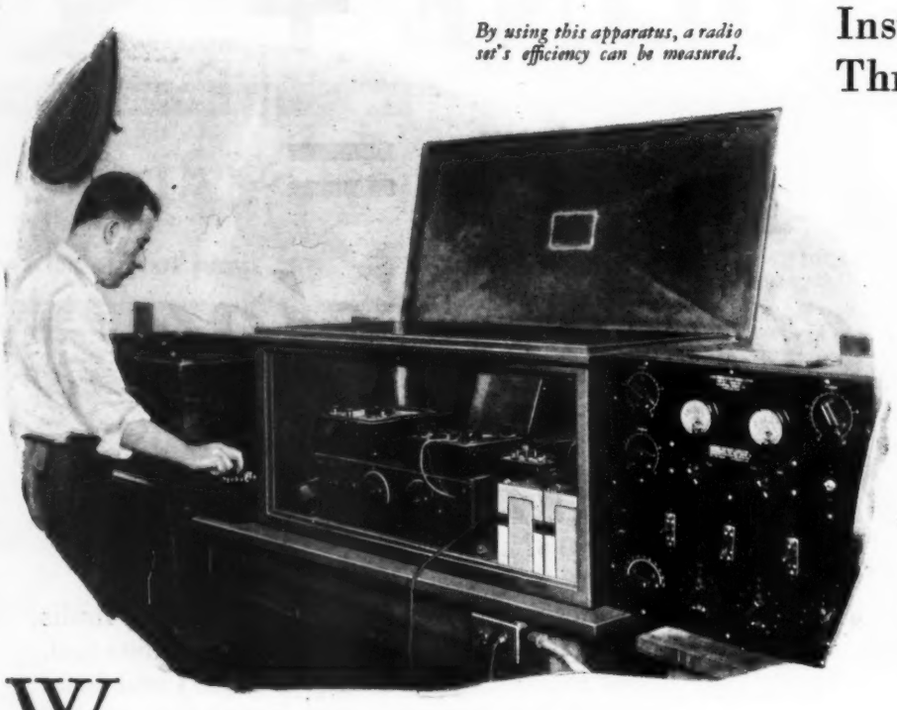
ETHYL GASOLINE CORPORATION, 25 Broadway, New York City. 56 Church St., Toronto, Ont., Can.

ETHYL GASOLINE

How the New Radio Sets Are Tested

Institute Puts New Sets Through Vigorous Tests

By
Alexander Senauke, M.E., E.E.
Assistant Director
Popular Science Institute of Standards



By using this apparatus, a radio set's efficiency can be measured.

WHILE radio engineers in industry have been making real strides in designing radio receiving equipment that comes closer to approaching the ideal, the Popular Science Institute of Standards has been concentrating at the same time on the development of more discriminating and precise tests for radio sets.

From the very first, all Institute tests of radio products have been of such a nature as to do away with the inaccurate human ear as a means of judging the merits of equipment. Always, quantitative or numerical measurements have been obtained which show, by the movement of a needle across a definitely marked scale, just what a product will or will not do. By devising tests that provide such measurements, the Popular Science Institute has had a real basis for determining the worth of products without personal opinions or guesswork entering into the matter in any way.

HOWEVER, there has been one point that has been causing difficulty. While test results definitely determine a product's performance, there have been no means of measuring these test results except by comparison. This was because there were no established performance units. Now, however, the standardization activities of engineering societies have provided absolute units for such measurements based on the actual action of incoming radio waves in producing an audible "signal" or sound at the loudspeaker. To find out the sensitivity, the selectivity, or the fidelity to tone of a radio receiving set, these measurement units are applied, and comparison as well as human hearing and judgment is eliminated from radio testing as carried on by the Popular Science Institute of Standards.

To make such measurements, the laboratory apparatus must duplicate in miniature the phenomenon that takes place in real radio transmission and reception. The carrier frequency voltages generated must be of a magnitude comparable to the voltages generated in actual broadcasting stations; provision must be made for known modulation with any of the components of speech and music.

THESE modulated radio-frequency voltages must be artificially reduced in strength in the space of a few feet, as though they had traveled a thousand miles or more.

The excess power must be thoroughly confined so that it cannot affect the most sensitive receiver while under test. In addition, a dummy antenna must be provided that will be electrically equivalent to the usual outdoor antenna, and suitable thermo and vacuum tube meters must be provided to give an accurate visible record of the receiver's performance.

The development of such apparatus is quite obviously a task of great magnitude. The above photograph shows in experimental form part of the testing apparatus that was developed by The Institute's staff to conform to these requirements.

Repeated tests and measurements made on a number of radio receivers of varying type indicate that this apparatus satisfactorily meets all requirements as to consistency of results, accuracy of determinations, and ability to test receivers of different design and sensitivity levels. The use of this apparatus provides information of a very definite nature regarding the set which is under test.

These comprehensive, accurate, and complete tests safeguard the readers of POPULAR SCIENCE MONTHLY against the purchase of inferior radio equipment. In fact, manufacturers value The Institute's tests so highly that we are frequently called on to test and report on experimental models before they are put into production.

Lists of equipment approved after test by the Popular Science Institute of Standards can be had free on request. Readers who are investing in a new radio outfit will find helpful the booklet "What the Radio Buyer Should Know." Besides full advice on buying and installing, nine pages of this booklet are devoted to operating hints that will enable one to get the best results from his radio outfit. Price 25 cents a copy. Popular Science Institute of Standards, 250 Fourth Ave., New York, N. Y.

Popular Science Monthly
GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY. THE PUBLISHERS

This *grainless* wood is workable almost beyond belief!

Can be cut out, punched, die cut and milled. Very dense and tough. Highly resistive to moisture. Has a smooth, attractive surface on the face side, and requires no paint for protection. Also takes any finish beautifully. Send for large free sample.

FOR STORE FIXTURES

American Industry is now pretty well aware of the fact that there is on the market a genuine all-wood board that is *grainless*, that won't crack, split or splinter, and that is highly resistive to moisture.

But there are still many manufacturers and mechanics who do not fully appreciate the truly remarkable workability of Masonite Presdwood.

Containing absolutely no foreign substance of any kind, Presdwood cannot damage tools. It can be used on saw, planer, sander, shaper. It can be cut out, milled, die cut and punched. It also assures economy in cutting panels to size. In fact, it practically eliminates all waste in cutting.

Presdwood has uniform strength, too. It is highly resistive to moisture. It is very dense and tough. It has a smooth attractive surface on the face side, requires no paint for protection, and takes any finish beautifully.

Wide, wide range of uses

Although it has been on the market only two years, Masonite Presdwood is already in use in scores of industries all over the country.

Presdwood is used extensively in paneling—alike in fine Southern homes, in stores and offices of the East and the Middle West, and in summer cottages of the great North woods.

It is being used in the manufacture of kitchen cabinets, medicine chests, cupboards, tension boards, work-bench tops, tables, desks, book cases, linen chests and china closets.

Toy manufacturers are large users of Presdwood. It is serving in hospitals as bedroom screens and as invalid trays. And it is especially efficient for table tops.

FOR PANELING

Laundries, bakeries and dairies are using Presdwood quite extensively. For example, it goes into the making of clothes hampers. And because of its strength and resistance to moisture, it is being built into bread boxes and patented dairy containers.

A number of Chicago railroads are using Presdwood as dust arresters for journal boxes; various foundries are finding it an ideal material for cooling trays for hot castings; it is also going in to the production of packing cases.

New and unexpected uses

Just recently a manufacturer of portable billiard tables became interested in Presdwood. He is especially impressed by its stout resistance to wear.

A manufacturer of electric light globes is putting Presdwood to a novel use. He bores holes into it to fit his bulbs, and thus they are held tightly while being etched.

Presdwood is also being used to line ventilators and elevator shafts—because of its excellent anti-rattle qualities.

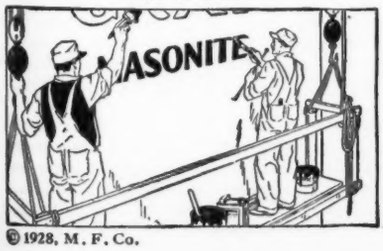
And before this advertisement reaches your eye a number of other Presdwood uses will have been discovered—some of them entirely unexpected uses.

Write today for a large free sample of Presdwood and find out what it will do for you.

MASONITE CORPORATION
Sales Offices: Dept.1298, 111 W. Washington St.
Chicago, Illinois

Mills: Laurel, Mississippi

FOR SIGNS



Masonite PRESDWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR RADIO CABINETS

© 1928, M. F. Co.

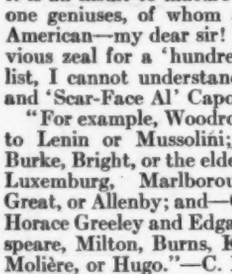
Our Readers Say—

A Shake-up in the Hall of Fame

"I REALLY was not aware that POPULAR SCIENCE indulged in humor as a reading of your list of thirty-one geniuses would indicate. Certainly, if this list is to be regarded seriously, it is an insult to mature intelligence. Thirty-one geniuses, of whom at least nineteen are American—my dear sir! In the compiler's obvious zeal for a 'hundred percent American' list, I cannot understand why Horatio Alger and 'Scar-Face Al' Capone were omitted.

"For example, Woodrow Wilson is preferred to Lenin or Mussolini; Daniel Webster to Burke, Bright, or the elder Pitt; U. S. Grant to Luxemburg, Marlborough, Frederick the Great, or Allenby; and—God save the mark!—Horace Greeley and Edgar Allan Poe to Shakespeare, Milton, Burns, Keats, Goethe, Heine, Molière, or Hugo."—C. M. N., Dominion, N. S., Can.

"In your selection of geniuses, you failed to remember that somewhere there is a country called Russia. This country had, and has today, some great masculine figures, namely Tolstoy, Tschaikovsky, Trotsky, and many others. Why be partial?"—S. S. Los Angeles, Calif.



"I hardly see how Isaac Newton can be left out of any list of geniuses. He was one of the most marvelous men of all history. And I see no reason for placing Grant in a list of thirty-one, and leaving out Charles P. Steinmetz."—F. B., Caliente, Nev.

"I'd omit Napoleon Bonaparte and substitute Nikola Lenin. I'd also omit Prince Bismarck, Charles Darwin, and Alexander Hamilton, and substitute Marshall Foch, inventor Tesla, and Dr. Voronoff."—F. V. B., Wolfpit, Ky.

As we are going to an age of aviation, there will be many votes for Charles Lindbergh, and the next ten years may prove them correct."—J. A. F., Goshen, Ind.

Bang!—The Last Word

"WELL, then, you may say to Mr. Lecky for me that it always takes at least thirty-one good men to equal one woman. Enough said."—An Old Cat from Boston.

Thank You, Sir Jagadis

"I THANK you for the article, 'Plants That See, Feel and Think,' regarding my researches. I think it is one of the very best that has been written."—J. C. Bose, Calcutta.

Why Not?

"I WONDER if you are aware that here in the University of California Experiment Station a plant physiologist has just succeeded in growing roses, dahlias and many other plants without any soil whatever. He simply plants the seedlings in water in which he has mixed certain chemicals needed for their growth. Hundreds of the plants have thrived and blossomed on this artificial chemical food.

"Some time ago in your magazine I read a discussion of the possibility that some day people may eat nothing but tablets of synthetic food. Apparently the idea isn't so far fetched as I thought at the time. If plants can live on it, why not people?"—N. D. R., Berkeley, Calif.

The Customers Speak Up

"IF YOUR magazine really had as much useful stuff to read about for twenty-five cents as Montgomery Ward has in their catalogue for nothing, I might be a regular subscriber."—Scotchy, Madison, Wis.

"Perhaps you would like to hear from a satisfied customer. Your articles are clear and correct. Your fiction is clean and interesting — the whole family reads it. Your aviation articles are excellent. As the world progresses, you progress with it."—R. H. B., Norway, Maine.

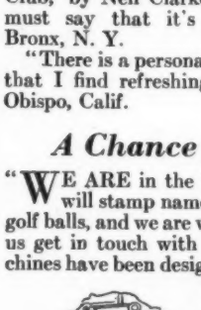
"Add my vote against so much aviation reading matter. For 'just folks' like me, flying is about as important as wings on a hen. It thrives only on printer's ink."—N. C., Memphis, Tenn.

"Just a line to let you know how I've enjoyed reading 'Flyers Who Rob Caterpillar Club,' by Nell Clarke, in your July issue. I must say that it's worth while."—J. O., Bronx, N. Y.

"There is a personal touch to your magazine that I find refreshing."—C. J. S., San Luis Obispo, Calif.

A Chance for a Birdie

"WE ARE in the field for a machine that will stamp names and advertisements on golf balls, and we are wondering if you will help us get in touch with inventors. Several machines have been designed to do this, we understand, but have not proved satisfactory. There are several on the market now that mark the balls by hand, but this is a very slow process. What we desire is a machine that will stamp printing matter on the golf balls automatically at the rate of 100 or 200 an hour. The machine must be able to use types of two sizes, in colors, and to print clear around the equator of the golf ball. The faster it prints, the better we'll like it.



"This is a problem that should challenge the spirit of inventors."—S-W. Co., Boston, Mass.

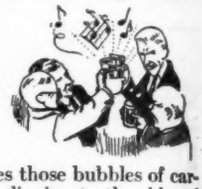
Eli and the Chicken

"PERHAPS other readers will be interested in this story of how Eli Whitney got his first idea for making the cotton gin:

"While standing by a crate of chickens, he saw a cat trying to pull a chicken out between the slats of the crate. The cat was able only to draw out feathers. In thinking the thing over later he saw the same scene with these changes: instead of the chicken he saw cotton with seeds too large to go through the slats. Instead of the cat, he saw a revolving spool with projecting bars pulling the cotton out, leaving the seeds behind."—J. F. D., Cincinnati, O.

What Is Your Answer?

"HERE is an interesting phenomenon I observed the other night. If a glass of carbonated beverage, ginger ale, for instance, in which there is loose ice floating, is jarred slightly, so that the ice is made to strike the sides of the glass, a certain tone is, of course, given out. Now, if the glass is shaken slightly but rapidly for a few seconds, this tone will be heard to rise perhaps as much as a half tone.



"The explanation of this seems to me to be that the shaking liberates those bubbles of carbon dioxide which were clinging to the sides of the glass. When these have passed out of the solution, the volume of the liquid is diminished, causing the ice to create a higher tone.

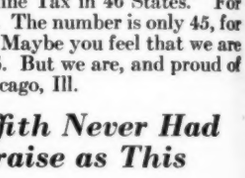
"I should like to know the opinions of some others on this."—R. G. D., Baltimore, Md.

A Bomb from Chicago

"I NOTE in the July issue, on page 58, a heading 'Gasoline Tax in 46 States.' For once you are wrong. The number is only 45, for Illinois has no tax. Maybe you feel that we are not part of the U. S. But we are, and proud of it."—W. H. J., Chicago, Ill.

Even Griffith Never Had Such Praise as This

"THAT movie the Movie Maker made turned out to be one horrendous spectacle, judging from what I can gather. Prehistoric monsters, Crusaders, Swiss villagers, and doughboys, all hashed up and 'shot.' Anyway, I see that the Movie Maker finally married his cutie. Thank God that's over."—Helen H., Philadelphia, Pa.



"I've lived in this movie town for eight years now, and I can say that 'The Movie Maker' was a realistic account of the way in which more than one determined young man has made his fortune in the game. Give us some more as good."—L. S. D., Hollywood, Calif.

More Model Ships Ahoy!

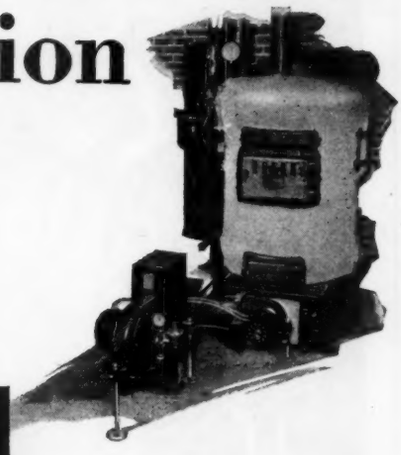
"I WOULD like to suggest to Captain McCann that his next model be a modern ship, for instance, the schooner 'Bluenose' which won the international schooner race for several years."—H. B. R., North Sydney, Nova Scotia.

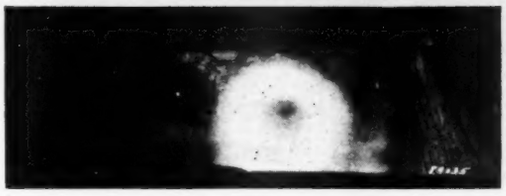
"I have built two yacht models, one Spanish galleon, and a thirty-inch single stick airplane, all from your blueprints, which contain every detail necessary."—C. H. S., Alsask, Sask., Can.

"Please tell me if Captain McCann is going to make any more ship models. I have been interested in his many articles, and hope he will continue to make them as worthwhile as your featured articles."—W. J., San Antonio, Tex.

With ELECTROL, you're sure of Correct Installation

Factory training of installation men is one of the many reasons why you are assured completely satisfactory performance from the Electrol Automatic Oil Burner.





Above: A typical installation. *Left:* Two actual photographs of Electrol combustion. Note remarkable flame diffusion in larger illustration; also how spark is directed into oil vapor. Lower illustration is a TD installation with oil shut off from one nozzle. Note spark showing on left and excellent combustion cone on right.

The men who install Electrol Oil Burners are trained at the factory. They are given thorough instruction in the correct methods of fitting Electrol to each type of heating plant.

Moreover, they are required only to install the burner—not to assemble it too. Electrol burners are shipped to the dealer completely assembled just as they are when they pass their final rigid test and inspection at the factory. Thus, you have double assurance of dependable operation right from the start.

Correct installation is part of the purchase when you order an Electrol Oil Burner. It has helped us and our dealers to build a successful business. It has contributed much to the satisfactory performance of Electrols in many thousands of homes over a long period of years.

A Blue Book of Electrol Owners would read like the social register of America. Electrol is heating some of the country's finest homes.

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Popular Science MONTHLY

FIFTY SEVENTH YEAR

SEPTEMBER, 1928 SUMNER BLOSSOM *Editor* VOL. 113, NO. 3

Making Over the Movies

The Movietone film presenting to America for the first time George Bernard Shaw speaking. On left edge of the film is the photographic record of his voice.

ENTIRE Film Industry Being Revolutionized As 400 Theaters Show Pictures That Speak and First Great Full-Length Talking Drama Is a Reality—Complete Musical Comedy Is Arranged For and in a Few Months It May Be Produced in a Thousand Auditoriums—How Remarkable Inventions Give Voice and Music to Silent Screen

By ALDEN P. ARMAGNAC

WILL talking movies, newest competitor of the silent drama, eventually usurp its place? That is the question on the lips of everyone who has watched its phenomenal spread throughout the country. Today the "movies you can see and hear" are presented in more than 400 theaters—from the Roxy in New York, seating 6,200, to the Sun Tower in Los Angeles, with a seating capacity of 900—and by the first of the year, it is expected that such theaters will number a thousand. For the first time in their spectacular history the "movies" are being made over.

Walk up New York's Broadway from Times Square, after dark, and what do you see? At the Gaiety Theater electric lights proclaim "*Fazil*—a Fox Production with Movietone Symphonic Accompaniment." "See and Hear George Bernard Shaw on the Movietone" urges the Globe Theater just beyond. The Mark Strand invites you to come in and see *Miss Information*, a Vitaphone playlet, and Movietone newsreels. And the Warners' Theater presents "*The Lion and the Mouse*, a Warner Vitaphone picture with Lionel Barrymore and May McAvoy—and other Vitaphone features."

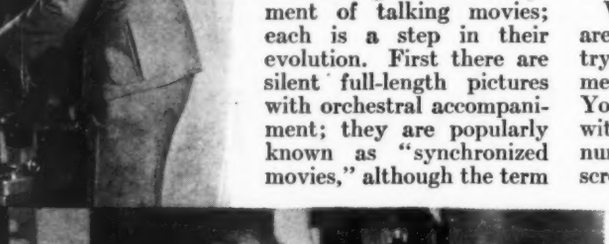
The smaller cities and towns have talking movies, too. Aberdeen, S. D.; Aberdeen, Wash.; Akron, O.; Albany, N. Y.—the list of towns and cities that have theaters equipped to show them reads like an encyclopedia.

"In five years there will be no silent pictures," says Jesse L. Lasky, vice president of the Paramount-Famous-Lasky Corporation. "Motion pictures are as much entitled to embrace sound as is the stage," D. W. Griffith, independent motion picture producer, declares. "We will have to learn when to add the whistles and sirens and fire-wagon gongs and when to leave them out," cautions Al Christie, maker of Christie Comedies. "We expect soon to be selling assorted noises with our films," predicts Hal E. Roach, comedy producer. And John Ford, director for Fox Film Corporation, says of the use of sound in movies: "The field of its artistic possibilities is not yet furrowed."

Despite popular impression, all-talking dramas are a new thing—so new that New York saw the first one, *The Lights of New York*, only a few weeks ago. Previously talking movies had been made with only a part of their length featured by audible dialogue, and the rest often filled out with a sound-recorded orchestral accompaniment.

IT IS hard to say just when talking movie experiments began. As early as ten years ago, San Francisco saw the second act of *The Merry Widow* rendered as a crude sound movie; and even before that experimenters had tried to adapt sound to the then-silent drama. Modern talking movies, however, date definitely from August 6, 1926, when the showing of *Don Juan* with Vitaphone orchestral accompaniment in New York heralded the first public demonstration of this new process. It had been developed in the Bell Telephone Laboratories. Mean-

Paul Hodge recording the voice of Raquel Torres, as a test for her in a talking film rôle.



Voice-recording device of the Vitaphone. Each disk records speech for one reel. The tonal arm is floated internally in oil.

jected in a theater, sight and sound are perfectly in step, the latter reproduced electrically through giant loudspeakers hidden behind the screen.

Several kinds of sound pictures now in vogue illustrate the gradual development of talking movies; each is a step in their evolution. First there are silent full-length pictures with orchestral accompaniment; they are popularly known as "synchronized movies," although the term really includes talking movies as well. Then there are short vaudeville sketches featuring music or monologue, audible newsreels, talking picture interviews with famous persons. Next the full-length films with short snatches of dialogue, and finally the all-talking drama.

The first variety, dispensing entirely with a theater's own orchestra, supplies the smallest theater with a program of the finest music. The score is recorded when the film is made. Widely known musicians and appropriate selections are chosen and arranged in perfect unity.

Vaudeville specialties in the "talkies" are proving a field for cautious producers trying out their apparatus and equipment. The other night I sat in a New York theater and watched an audience witness such a program. An opening number by a jazz orchestra, seen on the screen, and heard playing, evoked applause that ended suddenly when the applauders realized that the musicians could not hear them—it was like applauding a radio concert! Another orchestra melody met with silent response. But when a pair of young women sang from the screen in close harmony, the theater-goers spontaneously burst into applause again; a pair of comedians convulsed them with their quips; and after an opera singer had concluded the final selection the spectators abandoned all restraint and a roar of hand-clapping swept the theater. It was an impressive demonstration; for it brought home the possibility that here was a way of shipping "canned" vaudeville, talent of the first water, to the most remote theater in the country.

while another process, the Movietone, was being rushed to completion. Credit for its development is usually given to Earl I. Sponable, technical director of Fox Movietone. The first public demonstration of this invention took place in New York, January 21, 1927.

Some of the largest motion picture companies are licensed to use talking movies with either system, both of which are manufactured by the Western Electric Company. These include the Paramount-Famous-Lasky Corporation, the Metro-Goldwyn-Mayer Corporation, the United Artists Corporation, Warner Brothers, the Fox Film Corporation, the Christie Film Corporation, and the Hal Roach Studios.

Meantime a third process, the Photophone, was being developed by the Radio Corporation of America in the laboratories of the General Electric Company. This process is used by other motion picture producers, including the Pathé Film Company and the F. B. O. Studios, to make full length pictures with the accompanying music. These three systems are the best known. But there are others, including, to mention only a few, the Cortellophone, and the Vocafilm. And in England a number of theaters are showing talking films made by the De Forest Phonofilm process.

POPULAR SCIENCE MONTHLY has described in previous issues the technical features of the three important processes. Suffice it to say here that all use one of two basic principles. Either the sound accompanying a drama is recorded on a wax disk like a phonograph record—as in the Vitaphone process—or it is photographically recorded through an ingenious system on the motion picture film itself, as in the Movietone and Photophone processes. When the finished film is pro-

Miss Torres, actress, seeking a talking movie rôle, hands John Lancaster, studio casting director, a record of her voice.

AND at least one motion picture producer is preparing to transport bodily an entire musical comedy to the talking movies. *The Desert Song*, a light opera that has run in New York, Chicago and the West, is to be filmed by the Vitaphone and released within a few months.

Meanwhile, the adaptation of musical drama to the screen has brought about an interesting legal quandary. As this is written, a test case is pending over *Show Boat*, a Ziegfeld musical comedy based on the novel by Edna Ferber. A film company bought the movie rights before the musical comedy was made; now it claims as well the Movietone rights. Ziegfeld seeks to halt the production on the ground that every film shown would be a mechanical competitor of his show.

By recording the likenesses of great men in the talking film, it will be possible for future generations to see them while they talk. Among the first to take advantage of this opportunity are Calvin Coolidge, Col. Lindbergh, and George Bernard Shaw, noted Irish author.

In the first full-length talking movie, *The Lights of New York*, a Warner Brothers production, there is not a single printed subtitle in the seven reels. Spoken words introduce the characters in turn. A jazz band plays in a cabaret scene; a man sings and spectators sit at tables and converse in animated and audible

tones. And, as an example of the fidelity of talking film reproduction, a man enters through a door, and as he closes it the sound of music coming through the doorway dies away.

Meanwhile players are being selected for *Behind That Door*, another full-length talking drama, by the Fox organization. This picture, it is announced, will use dialogue and sound effects throughout.

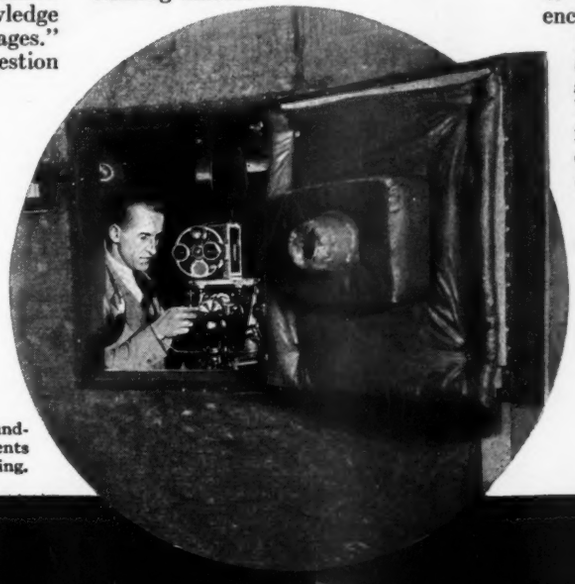
Talking movie dramas have created a host of new problems for the producer to face. Not all of them are technical. Recently a Pennsylvania court held that the State Board of Censors must approve dialogue as well as scenes before a talking film could be released. Another more serious question facing producers is that of the foreign rights of a talking film. Obviously a film made in America, in which the characters speak in English, can be exported only to Great Britain. "We'll worry about the French and Spanish rights later," says Ben E. Jacksen, executive manager in charge of Movietone production. And Roy J. Pomeroy, technical director of the Paramount-Famous-Lasky studio, predicts as an outgrowth of internationalized talking movies "universal knowledge of two or three common languages."

Another problem concerns the question of "synthetic music." The American Federation of Musicians, comprising 158,000 members, has just voted a defense fund of $1,500,000 a year to combat the introduction of sound-film devices in theaters. "We are not opposed to talking movies," its president, Joseph N. Weber, declared recently, "but if the machines are used as a substitute for vocal and orchestral music in the nation's theaters they will become a menace to our cultural growth."

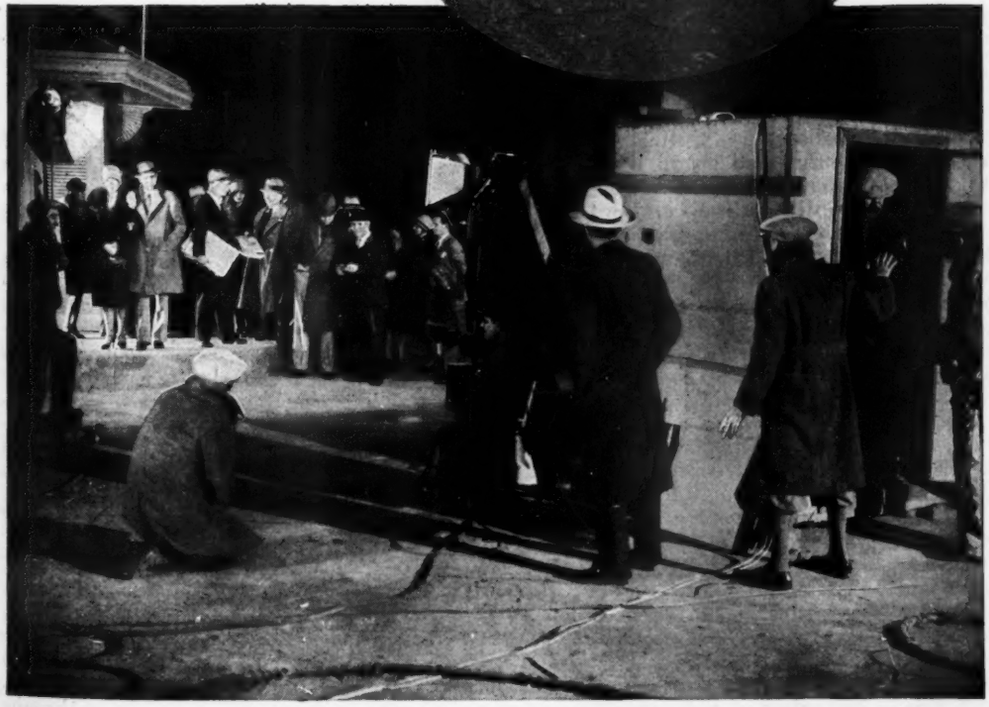
His views are not shared by S. L. Rothafel, or "Roxy," owner of the largest talking-movie-equipped theater, and an honorary member of the Federation. "This is a new sign of progress," he says, "and musicians should hitch it to their own uses."

The stage has an important link with its new-born cousin, the talking movie. Its graduates are already trained to play in sound films; dramatic critics point out that players with previous stage experience, such as Lionel Barrymore, to mention but one, give far more pleasing performances than others whose voices have not been specially trained by long practice.

FAR-SEEING actors and actresses in the California film colonies are already rushing to voice culture schools. The voices of some stars are hopeless for talking movies, but others, particularly those with stage experience, are well suited to the new systems. The First National studio has instituted compulsory voice classes for its players and Fox and other producers plan similar training classes.



Movie camera in the soundproof booth that prevents recording of its clicking.



Making a street scene in the all-sound Vitaphone drama, *The Lights of New York*. At the right is the camera housed in its soundproof booth that prevents its clicking from marring the speech of the actors. In this scene of the talking drama newsboys cry their extras. In the seven reels of this picture there is not a printed sub-title.

When players are selected today for a talking movie cast they are given both screen and voice tests. One Western technician, John Hodge, has even arranged to provide job-seeking players with test records of their voices, to be submitted to casting directors, thus dispensing with the delay of a voice trial.

It is said that G. Bernard Shaw, whose "speaking likeness" recently greeted Americans from the screen, insisted that he be permitted to see and hear his pictured interview before its release. But when the picture was shown and he heard even the twittering of birds in his garden where the picture was made, he approved at once.

Less composed was Alfred E. Smith, Democratic nominee for president, when he recently posed. Spectators saw him take out his handkerchief and mop his brow as he complied with the photographer's request. And Michael Hainisch, President of the Austrian Republic, was frankly overcome with consternation not long ago when the talking movies recorded an address to the Franz Schubert Seminary. President Coolidge, veteran of many a radio address and camera encounter, faced the sound camera unperturbed. But the thoughtless slip of another prominent political figure spoiled one photographer's whole day. When his speech, prepared in advance for newsreel distribution, was run over in the projection room, it was discovered that at one point he had said "facilitate" when he meant "felicitate." The film was released without the talking part.

ONE concern, making newsreel sound films, has a special field outfit used for talking interviews and newsreels. This picks up with the picture such sounds as the hum of an airplane's motor or the tramp of a marching army. This ingenious apparatus is transported in a motor truck and with it go a camera man and a "sound man."

Co-directors are necessary for talking movies. One attends to the picture; the other, known as the technical director, to the sound. The latter sits at what is known as a monitor desk, on a platform twenty-five feet above the stage, and controls the entire electric recording system. Through a heavy glass plate that no sound penetrates he commands a view of the whole stage, and four large wooden loudspeakers behind him tell how the sound effects are being recorded. His only communication with the picture director is through a miniature telephone system.

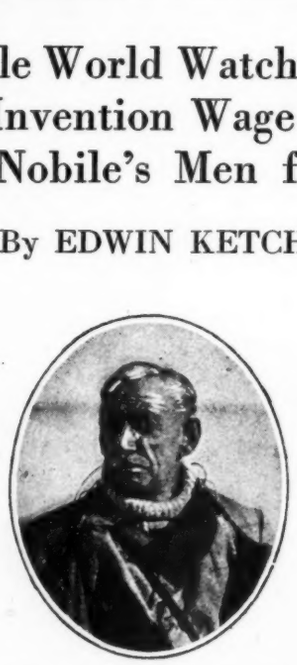
Whether the venture into this fascinating new field of movie art turns out to be a gigantic success or a colossal failure remains to be seen. But the men who head the big companies are of the conviction that the talking motion picture is revolutionizing their business.

Lost *in the* Arctic

Last photograph of the *Italia*, taken at Spitzbergen just before her start on the North Polar flight on which she met disaster. Above: The *Italia* flying over Milan, Italy.

The Whole World Watches Heroes of Modern Invention Wage Grim Battle to Save Nobile's Men from the Ice

By EDWIN KETCHUM



Capt. Roald Amundsen, lost in the Arctic in his attempt to rescue his estranged former comrade of the *Norge* Polar trip.

IN A banquet hall at Oslo, Norway, a few weeks ago, famous explorers of the Arctic gathered to honor Capt. George H. Wilkins and his pilot, Lieutenant Eielson, for their daring airplane dash from Alaska across the Polar Sea. Among the guests was Capt. Roald Amundsen, discoverer of the South Pole and hero of the polar flight of the dirigible *Norge* in 1926.

On this banquet broke the news that the airship *Italia*, in which Gen. Umberto Nobile has just completed history's fourth conquest of the North Pole, was many hours overdue in a battle with a storm on her return trip. The dirigible's radio, which miraculously had kept the world in touch with her progress, now was ominously silent. There was fear that disaster had befallen the ship and her crew of sixteen men, lost somewhere over the desolate sea of ice between Spitzbergen and the Pole.

Italy had called upon the government of Norway to lead the rescue, and Norway now appealed to Amundsen.

A tense moment followed. Every man recalled the bitter quarrel that had grown between Amundsen and Nobile following the flight of the *Norge*. What would Amundsen answer? All eyes turned to him.

The weather-worn face of the grizzled Viking betrayed no sign of inward conflict. "Tell them," he said, "I am ready to start."

That stirring scene—the veteran explorer offering his life to aid an estranged rival in peril—opened a titanic drama of rescue—an epic of valor, of mechanical and inventive mastery surpassing anything in the records of adventure. The events which have followed the *Italia* disaster form a story of stark tragedy and superhuman deeds which, at this writing, still hurries on to a climax no man can guess.

For weeks, now, through the magic binoculars of radio, the world has witnessed a bewildering succession of heroic episodes in the Far North. The story of Nobile's rescue, and of the uncertain fate of his scattered comrades, has left us stunned by its immensity.

Millions marveled as radio, in the rôle of messenger and savior, guided flying rescuers to the little floating ice cake where the *Italia* crashed from the sky, and where Nobile and his pitiful handful of survivors struggled for their lives. More millions imagined the fate of the seven blown away in the wind-driven balloon; of the three who set out on foot in search for land. They anxiously watched as the nations of Europe mobilized men and machines—dog sleds, ice-breaking ships, warships, airplanes, and seaplanes—to penetrate the ice-locked wilderness. They saw fearless flyers from many lands wing northward on a seemingly hopeless search.

Then, from afar, they beheld the grim battle—men with their modern machines and inventions, pecking and stabbing to

The crew of the *Citta di Milano*, base ship of the Nobile Polar expedition, clearing a road through the ice for the landing of supplies at Kings Bay, Spitzbergen. It was this supply ship that received by radio the first news of the *Italia's* crash, and of Nobile's plight.

General Nobile in the doorway of the *Italia's* gondola, greeting the throng at Stolp, Germany, after the airship rode through a heavy European storm.

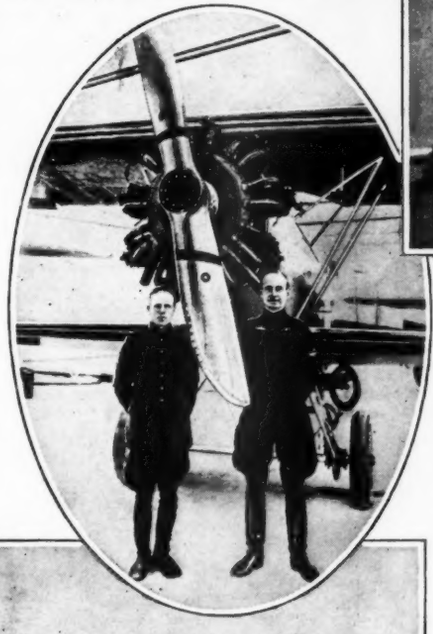
loosen the cold hand of the Arctic giant from the prisoners it clutched. They saw Amundsen and the French Navy pilot, Rene Guilbaud, fly northward, to be swallowed, too, and lost in grim silence.

Early this year the *Italia* had been prepared for what was to have been the crowning achievement in scientific exploration of the Polar regions. As navigator of the *Norge* on its historic flight across the Pole, Nobile had gained first-hand knowledge of Arctic weather and flying conditions. His semirigid airship, the *Italia*, a sister ship of the *Norge*, had been designed and equipped especially to make scientific observations. At the North Pole he was to plant the flag of Italy, and set a cross given him by the Pope in Rome.

TO ASSURE success, Kings Bay, Spitzbergen, had been splendidly equipped as an airship harbor, and the steamer *Citta di Milano* had been sent there to serve as a mother ship, supply base, weather observatory, and radio station.

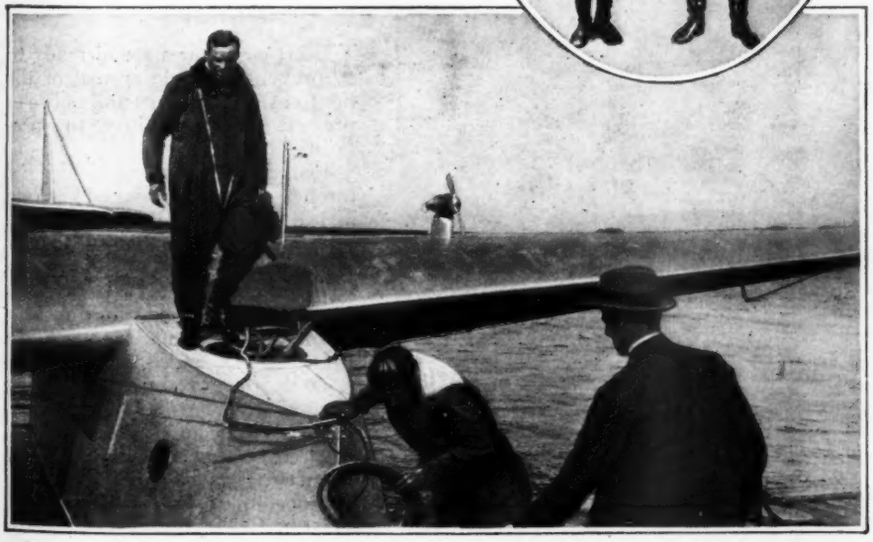
Nobile set out with supreme confidence. "In Polar exploration," he said, "experts who know how to travel on the ice are no longer needed, and men who know how to navigate the air take their place." He was to learn by bitter experience that, with all the progress in aerial navigation, man still has not subdued the Arctic desert of ice and snow.

From the outset mishaps and delays upset Nobile's carefully laid plans. It was not until April 15 that the *Italia* sailed from Milan. Over Europe a terrific hail storm tore her propellers and damaged the ship. Other Arctic explorers feared that the advancing season with fog and breaking ice would make conditions hazardous, but Nobile would not turn back.



The *Italia* set out from Kings Bay on May 11 on a sort of trial flight, but had sailed for only seven hours when a blinding snowstorm drove her back to her hangar. Here, for three days, her crew battled a raging blizzard, barely saving the ship. The supply ship, locked in the ice, had to be freed with dynamite.

AT LAST, on May 15, the *Italia*, shining silver in the sun, set out to explore the uncharted ice pack as far as the half-mythical Lenin Land, more than a thousand miles away. The eastern coast of this bleak island had been discovered north of Siberia in 1913 by Russian ice breakers, but the western coast never had been seen. Hour after hour the *Italia's* motors roared through the northern stillness, while radio messages told the world of her progress. As she neared her goal, freezing fog coated the ship's envelope with ice and weighted her down. Head winds joined against her. The breaking ice coat, caught in the wind stream of the propellers, crashed against the understructure, threatening to pierce the bag. The *Italia* turned about and on May 18 was back in her (*Continued on page 122*)



Major Maddalena, refueling near Amsterdam, standing on the seaplane from which he dropped provisions to the Nobile party. Above: Captain Lundborg (right), aviator who rescued General Nobile.

Huge Buildings Burned to Learn Secrets *of* Fire

Firemen Idly Watch While Walls Topple and Effects Of the Flames Are Recorded

By H. C. DAVIS

Two buildings within less than a mile of the White House, filled with safes and filing cases, being burned to study in detail the action of fire.

TWO brick business buildings in the heart of Washington, D. C., one of them five stories high, were deliberately set on fire recently. While most of the city slept, and more than 150 firemen with high-powered apparatus stood idly by, flames shot skyward, walls toppled and crashed amid showers of sparks.

It was one of the most spectacular scientific experiments ever attempted. From a safe vantage point in a dugout "observatory" near by, engineers with sensitive heat-recording instruments read the story of the fire's progress from moment to moment. They saw the flames spread with amazing rapidity until they melted iron. They saw floors burn away and plunge metal safes and cabinets into the furnace below. In less than an hour they saw both buildings reduced to a tangled mass of red-hot ruins.

Ruins of the experimental fire, showing safes containing thermometers and clocks that were given to the flames.

The purpose of the experiment, directed by Simon H. Ingberg, chief of the Fire Resistance Section of the Bureau of Standards, was twofold: first to measure the intensity and duration of unretarded fire in buildings; second to test the fire-resisting qualities of standard types of safes and metal filing cabinets now in general use.

The buildings were abandoned structures which were to have been simply demolished to make room for new Government buildings. They stood near the National Museum less than a mile from the White House. Both were typical of a fairly old type of construction still common in American cities.

At fifty different points within the buildings were placed thermocouples, which registered electrically the heat produced at each point. Forty-five more were placed so as to be buried in the debris. All were connected by wires with recording instruments in the near-by observatory.

Some thirty-five types of safes and many filing cases were distributed throughout the buildings. They contained useless old records and waste papers, thermometers to record the highest interior temperatures during the fire, and clocks designed to stop when heavily jarred, thus recording the time at which each safe fell through the burned floor. Waste lumber was placed in the buildings to simulate wooden furnishings.

Several days after the fire, which gained a temperature of 3,500 degrees F., the safes became cool enough to be opened. This one kept its contents intact from the ravages of the fire.

FIRE companies stood ready to prevent possible spread of the fire to other buildings and police to prevent possible injury to spectators.

Just at dawn Ingberg applied the torch to a pile of oil-soaked kindling in the larger building and within fifteen minutes the whole place was a seething furnace. In the first few minutes, some of the thermocouples melted and stopped working at a temperature of 2,800 degrees F. In a few places the heat ran as high as 3,500 degrees, or above the melting point of iron.

Forty-eight hours after the fire apparently had burned out, and after two heavy thundershowers, thermocouples in the debris still registered as high as 1,000 degrees. And several days later the safes were still too hot to be opened or removed.

New Jobs for Old Metals

Like an employment agent for industry, the chemist considers the elements and weighs their qualifications, putting them to work where they are most needed and most useful in the world's work.

Seventy-nine of the Ninety Known Chemical Elements Are Idle, and Industry Offers Riches to Whoever Can Put Them to Work

By E. E. FREE

Three hundred dollars worth of iridium, the costliest useful metal, used in jewelry, fountain pen nibs, and false teeth.

A BIRD that stops to sip water from the ocean is making as much use of that ocean as man is of the vast possibilities that lie in the chemical elements.

In this article, Dr. Free, widely known chemist, points out that seventy-nine of the ninety known elements in the world have never been given a real job. Eleven do the work while the rest hunt employment. Fortunes await those who can find big jobs for them. This article will set you wondering and thinking.

A COUNTRY where eight tenths of the workers were always looking for jobs would probably not be prosperous. Yet that is precisely the situation of the great modern empire of chemistry to which the world already owes so much.

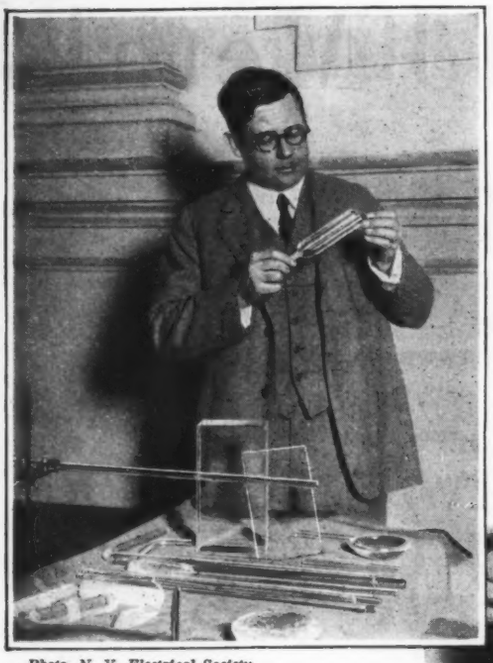
There are ninety known elements—the workmen upon whom the chemist must depend for everything he does. Only eleven have found jobs really suited to their powers. The other seventy-nine are still sitting around on benches in the chemical employment office, waiting for jobs, or else they are industrial misfits—not quite suited by character or abilities to the work that industry has forced on them.

Iron, useful as it is, is one of these misfits. Paint is its badge of failure. Many of its present jobs require it to stand out in the weather. That is something iron cannot endure. The rust bill of the world has been estimated at five billion dollars a year. It is rust and not use that wears out railway rails and ruins farm machinery. It is to resist rust that we pay a large part of the world's enormous bill for paint and painters.

Iron would have only inside jobs, safe from rusting weather, if chemists could only persuade some other elemental workmen to take over its outside tasks.

This is really the chief business of the modern chemist. On his desk lie scientific reports like letters from job-seeking elements. On that same desk are other imploring letters from elements that are overworked, like tin, lead, and mercury; elements desperately in need of help if the work of the world is to be well done.

Precisely as ordinary employment agents try to fit their human job-hunters to their open jobs, so the chemist tries to place each of his idle



Photo, N. Y. Electrical Society

Dr. E. R. Berry, General Electric Company, who helped develop fused quartz for ultra-violet glass, holding a fused quartz tuning fork, which keeps pitch at any temperature. Right: A thermometer of gallium in quartz tube that records temperature of 1,000° C.

elements in some work that it can do and do well.

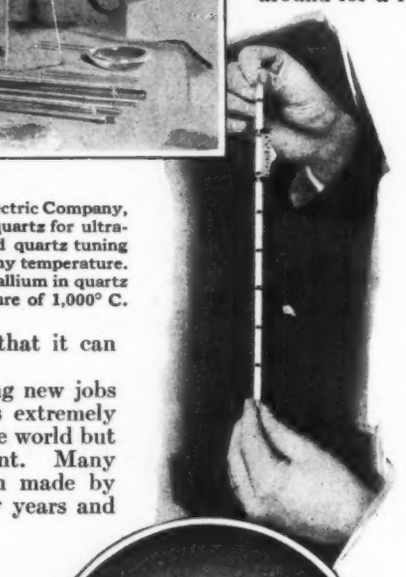
This business of finding new jobs for chemical elements is extremely profitable, not only to the world but to the employment agent. Many fortunes have thus been made by chemists in the last fifty years and more are being made now.

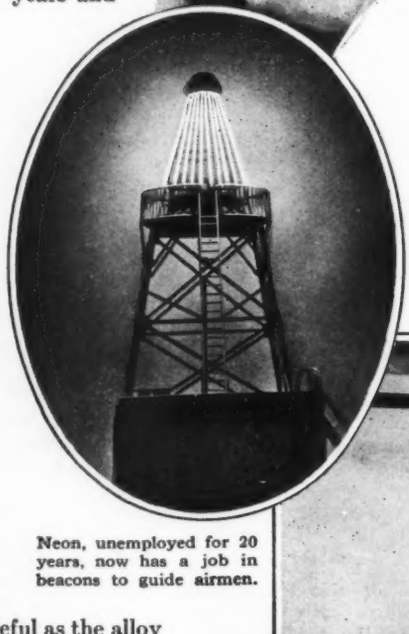
One element has sat idle since its discovery—for 139 years—as able to work as iron and perhaps as plentiful. This is titanium. Its idleness is not easy to understand. Titanium is a tough, hard metal, grayish in color, reasonably workable and reasonably rustless. It can be used to make tools and implements. It might even support buildings, as iron now does.

THERE are vast deposits of titanium ores in a dozen countries. It is true the metal is not too easy to refine and there are no known alloys of it as useful as the alloy of iron that we call steel. But iron, too, was hard to put to work when it was new. It needed centuries of effort by smiths and chemists to perfect the modern uses and varieties of steel.

Two elements whose history suggests the industrial "floater," getting job after job, only to lose them, are sulphur and iodine. Sulphur once was needed to make gunpowder; but smokeless powders were invented, giving that job to the element nitrogen, which they contain. Then the doctors hired sulphur to do odd jobs of cleaning up the germs after epidemics; but improved fumigating materials came along and sulphur lost another job.

Meanwhile a new process of extracting sulphur cheaply from buried deposits in Louisiana and Texas was perfected and the world's supply, previously obtained chiefly from volcanoes, was increased until there is now much more than anybody can use. The chemical employment agents are hunting things for sulphur to do on a large scale; and with some promise of success, especially for fertilizers and other agriculture uses. But at this moment, though it has several minor side lines, sulphur is still looking around for a full-time job.





Neon, unemployed for 20 years, now has a job in beacons to guide airmen.

From one of its best jobs iodine was fired only recently. A few years ago tincture of iodine was the badge of carefulness on every cut finger and scratched knee in the land. Now new chemical workers do this job more effectively, and iodine exists in quantities enormously greater than can now be used. It is a by-product in the manufacture of Chile saltpeter in South America.

SILICON is actually the second most plentiful element in the accessible part of the earth, surpassed only by oxygen. Yet it has no job, perhaps because it has sent only its picture and description to the chemical employment office. Even among chemists few have seen the hard, dark-colored crystals of silicon. In the form of one of its chemical compounds with oxygen, silicon is everywhere. It forms the mineral called quartz, and all the sandstones and seabeach sands of the world are made of it. Recently chemists who have tamed high temperatures in the electric furnace have persuaded silicon to let itself be separated from its compounds more easily and cheaply. Soon it may visit the chemical employment offices more frequently. Then, probably, someone will spot it for a big job somewhere.

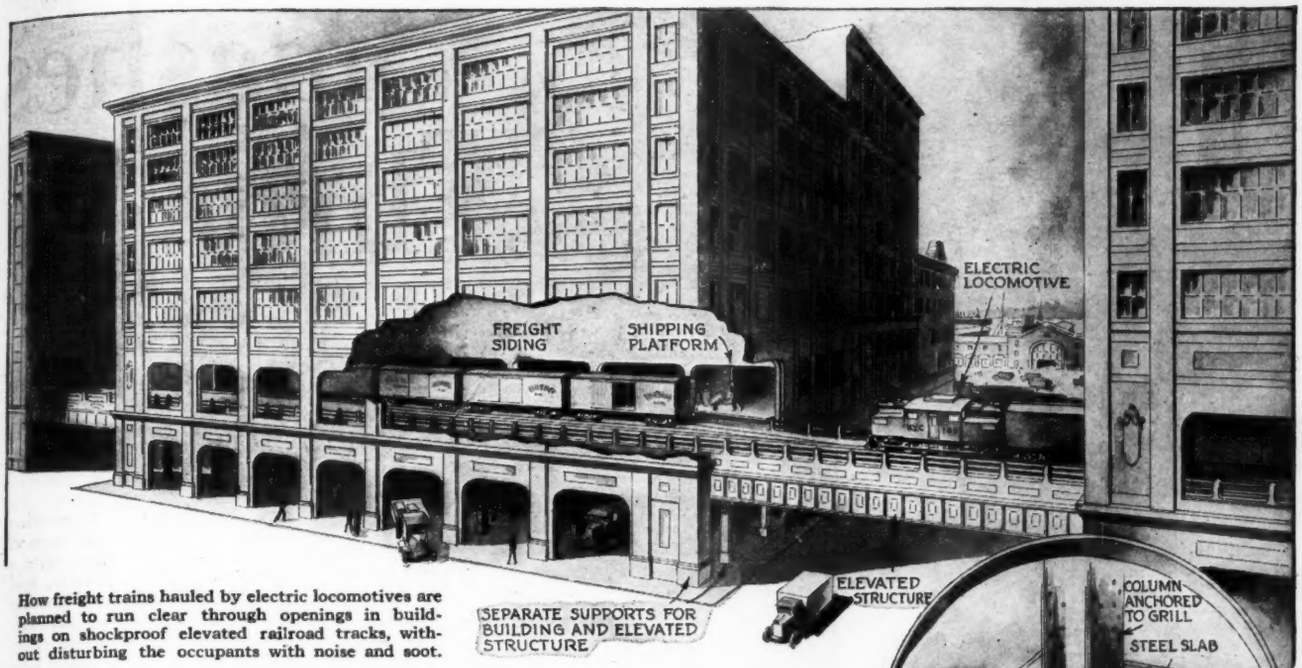
LIKE too many human workers whose own faults prevent their holding good jobs, there is a chemical element so violent and temperamental that few care to have it around. This is fluorine, which bites everything that comes near it. One compound of fluorine is that eroding ink that is used for writing on glass. Another compound is used to etch the insides of the frosted electric lamp globes to make them white, for fluorine dissolves glass and comes about as close as anything known to being that long-sought "universal solvent." Fluorine gets a few jobs, but in the main the vast deposits of its ore lie unused and the corrosive compounds of the element, held in wax bottles which they cannot dissolve, sit around unsought on the chemist's shelves.

Little-known metals like manganese and molybdenum are tried out once in a while on some special task—molybdenum has been used to make the inside parts of some radio vacuum tubes—but never manage to make good in a big way. Four metals of this class are newcomers, for only recently have chemists succeeded in making them in easily available form. These are thorium, uranium, vanadium, and zirconium. The first two, recently produced by Dr. Harvey C. Rentschler and his associates of the Westinghouse Lamp Works in their remarkable vacuum furnace heated by powerful radio waves, are slightly radioactive, sharing in some degree the marvelous powers of radium.

Then there is the family group of the lightweight metals, magnesium, lithium, and beryllium; (*Continued on page 144*)

Thirty articles representing new uses chemists have found for sulphur. They include an automobile gear shift knob, radio horn, shampoo, cement, table top, and floor lamp base.

A Railroad on Cushions



How freight trains hauled by electric locomotives are planned to run clear through openings in buildings on shockproof elevated railroad tracks, without disturbing the occupants with noise and soot.

Soundproof Freight Trains to Run Through Holes in City Skyscrapers

By JOHN WALKER HARRINGTON

NEW YORK CITY is to move a railroad off its streets. It is going to rip up the freight tracks of the New York Central Railroad that now run along Eleventh Avenue, known as "Death Avenue," and turn them into an elevated line. Straight through the block between Tenth and Eleventh Avenues the new railroad will run, burrowing through skyscrapers, hotels, and great apartment houses. Yet the occupants of those buildings will never know, by any sound, that a freight train is passing just beyond their walls.

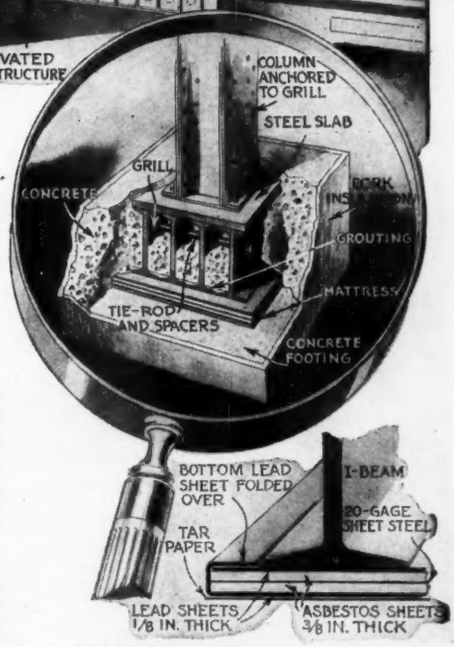
Vibration, the engineering name for the nerve-rasping screeches and shocks that ordinarily pulse through steel columns and beams, is the greatest problem that technical skill has met and conquered—but not the only one. The trains must be silent. They must be sootless. Over cross streets they must run on specially-designed bridges. It will be years before the railroad can be moved completely to its new route; yet today the general plan has been worked out by a committee of engineers of the state and city, the New York Port Authority, and the railroad.

Primarily it was adopted to remove the menace of chugging locomotives from the street traffic of "Death Avenue"; and city, state, and railroad will jointly share the cost of eliminating grade crossings. But the railroad plans to go further, and spend more than a hundred million dollars to establish a private right of way through the city. It expects to get back this money in revenue from office, factory, and apartment leases in buildings erected directly over the tracks.

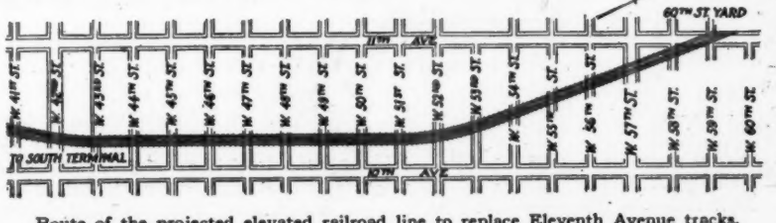
SO THAT freight trains running through veritable holes in these buildings may not jar them, elevated tracks will rest on supports separate and independent from building supports. As a further precaution, each column that bears the elevated's weight will have a springy, rubberlike foundation to absorb shocks. Rubber itself could not be used because it would flatten out under great weight; but a substitute has been found in an inch-and-a-half-thick mat consisting of a core of sheet steel with layers of asbestos and sheet lead on each side.

Even switches and sidings are to be laid in the interior of buildings, to serve factories or industrial structures along the railway line. These tracks, too, will rest upon separate columns carefully placed so that they cannot communicate their vibrations to the skeleton of the building. Air spaces, cork mats, and webbing in the concrete bases will help absorb jars. Such hum- and buzz-proof underpinnings have already been tried out successfully elsewhere in New York, where hotels and office buildings span present railroad tracks near the Grand Central Terminal.

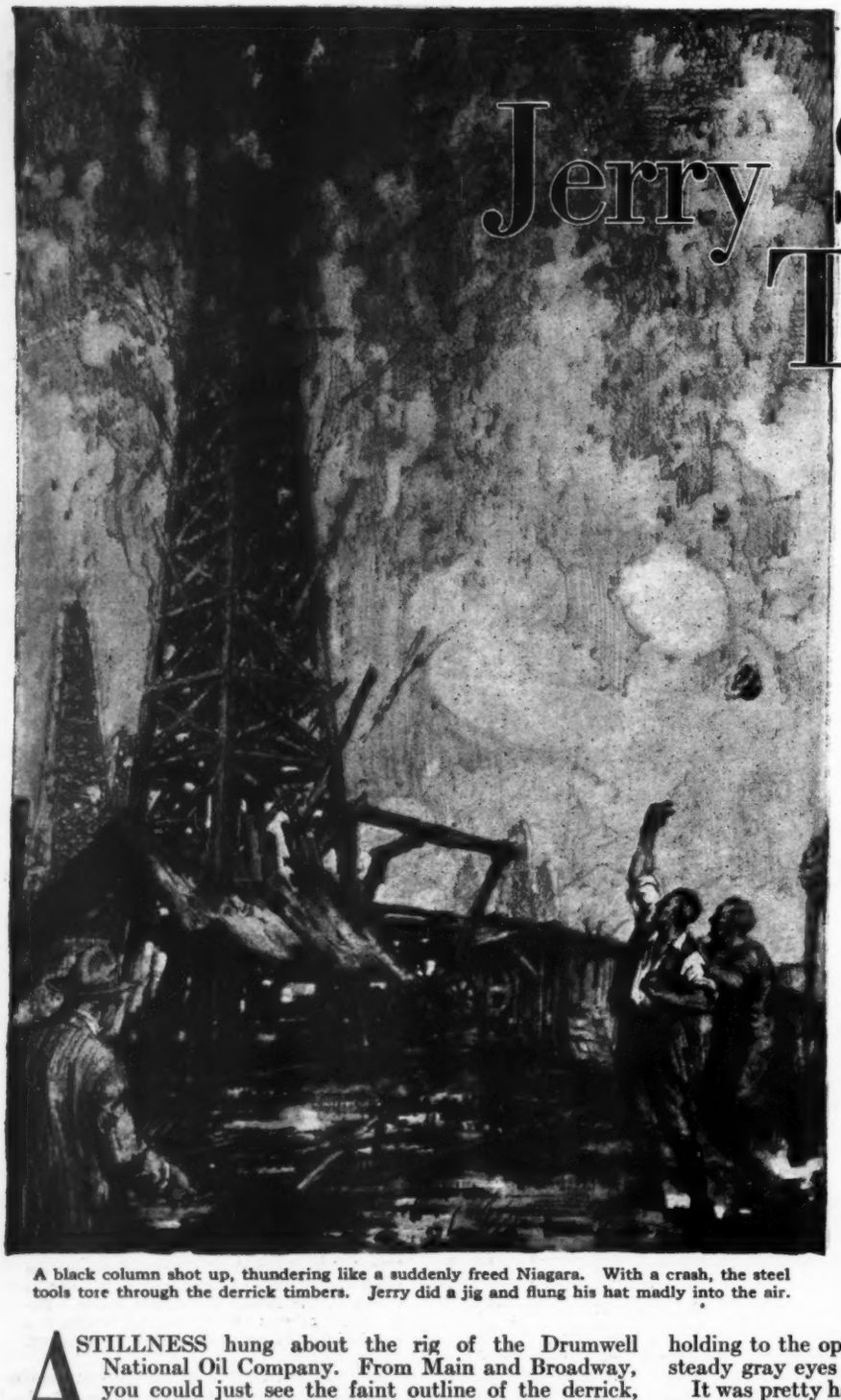
Electric locomotives will help minimize noise and soot. Experiments in Berlin have shown it possible to build a nearly noiseless elevated railroad. Taking a lesson from these tests, engineers plan to use concrete and ashes on the roadbed of the new structure to deaden the sound of trains.



The design of the shock-absorbing foundation upon which each elevated pillar will rest is shown in the broken-away view above. Between the column and its concrete footing is a cushioning mattress, as shown in lower diagram.



Route of the projected elevated railroad line to replace Eleventh Avenue tracks. Notice how it will cut through entire blocks of buildings and bridge the cross streets.



A black column shot up, thundering like a suddenly freed Niagara. With a crash, the steel tools tore through the derrick timbers. Jerry did a jig and flung his hat madly into the air.

Jerry Smashes Through

By

JESSE F. GELDERS

Illustrated by Hanson Booth

ONE day in August, sixty-nine years ago, a well-driller named Drake saw his tools drop into a crevice sixty-nine feet down and strike oil. The black liquid flowing that day at Oil Creek, Pennsylvania, has grown into a Niagara of industry. Drake's well gave up twenty-five barrels a day. Now the world's yearly petroleum production runs close to a billion barrels. Last year American motors consumed nearly ten billion gallons of gasoline alone.

This story is a romance of oil, industry's fascinating adventure in which fortunes are made and lost.

A STILLNESS hung about the rig of the Drumwell National Oil Company. From Main and Broadway, you could just see the faint outline of the derrick, tapering above the scrub oaks on the hill, far to the north of town.

In the other direction, and closer, a bristling forest of rigs marked the rich oil pool which had brought Drumwell into existence and fame. Oh, that was a pool! Even now, trucks were rumbling along Broadway with supplies for new drilling: timber, engine parts, casing, pipe fittings. In the dark of morning, when the countryside was nearest to quiet, you could hear the engines pumping oil from the older wells with irregular, resonant chugs, like giants coughing.

There had been half a dozen attempts to find oil under the hill to the north, too, but all had ended with dry holes. The failure which seemed to have overtaken the Drumwell National's venture, however, was of another sort. It was premature. The cable had broken and the tools had fallen into the uncompleted well.

In the company's office, a small storeroom in a frame building on Main street, Buck Norden had just told of six weeks' vain efforts to fish out the tools. Discussion of plans for the future was approaching a row.

"Abandon the well? *After drilling four thousand feet?*"

"What else is there to do, when three ton of steel tools are jammed at the bottom of the hole, and you can't recover them?"

"Sidetrack them. Blast them to one side, or pound them over!"

"No. That's not practical."

Purdy Vincent Bolton, the vice president, stood up in his khaki breeches and shining, mudless boots, obviously convinced in his own mind. But Jerry Crandall, the young fellow who had been driller, was insistent.

"It's been done before," he asserted.

Jerry was leaning back in his chair, idly holding to the open front of his corduroy vest, but training his steady gray eyes appraisingly upon the vice president.

It was pretty hard to figure just how much Bolton really knew about the oil business. One did not want to judge him unfairly. His manner was so genial, and his smile so ready, that they almost made up for his pompous speech and his movie attire, chosen as if for rough, dirty work—yet never dirtied. He was ordinarily so tactful that you could almost forget the poor taste of the sign on the broad front window of the office he had established. Gilt letters as large as the ones in "Drumwell National Oil Company" announced: "Purdy Vincent Bolton, Vice President and General Manager." It was just a little precaution lest anybody underestimate him.

"WE APPRECIATE your suggestion," he said to Jerry, in his rich, strong voice, "but it's not practical."

"Don't you think we at least ought to consider it, Mr. Bolton?" urged a little man with a salt-and-pepper moustache, who had come from the East to represent some of the stockholders. He was badly worried and eager to grasp at anything, for there was not enough money to put down another well.

"You know," he continued, "we've already spent upwards of a hundred thousand. The stockholders are not wealthy men.

They're just small-town merchants and farmers, most of them."

"Yes, yes, Mr. Galt." The vice president crinkled his florid brow and lowered his voice to a sympathetic softness. "Then there doesn't seem to be any practical course but to liquidate and sell the lease for whatever a purchaser will pay."

"All the money we've spent for drilling would be lost?"

Bolton nodded sorrowfully. "There doesn't seem to be any other practical alternative, Mr. Galt."

Now, at Galt's request, he took up Jerry's proposal with forced patience.

"YOUTHFUL enthusiasm," he admitted, "is a fine thing. But often it isn't practical. Now—but wait. It would be cheaper to go on fishing for the tools awhile longer. Do you think——?"

He turned questioningly to Buck Norden.

"I might be able to get them out," Norden replied with an expressionless stare.

"But you said before that you couldn't," Jerry challenged.

"They're wedged in pretty tight," Norden admitted, still with a blank gaze.

"Then let me go ahead and sidetrack them," Jerry demanded.

"Now see here," said Bolton, turning directly to Galt, "that would be a large amount of additional expense. Mr. Crandall is an extremely competent young man, and I would like to please this whim of his. But it really doesn't look as if we would get oil there anyway. It's a wildcat well, an experiment in unproven territory. There have been six dry holes on that hill."

"But, Mr. Bolton, everybody knew that before we started," Jerry argued. "I knew it, and still I took part of my wages in stock in the company, didn't I? The idea was that none of the others had gone deep enough. We were going six thousand feet if necessary. You know we didn't expect oil at four thousand."

"Yes, young man, that is true, but——"

"Well, I'd hate to see this well abandoned now. I'd be willing to go East myself, and talk to every one of the stockholders. This well can be saved. I can show them where it's been done before!"

"Young man—" Bolton was about to reply impatiently, but controlled himself. "Of course," he said, smoothly, "if I thought it could really be done——"

GALT spoke. "Let's give it a try, Mr. Bolton. We've gone so far already."

"Mmm." The vice president hesitated. "Very well then. Fair enough."

When the details had been arranged, and Jerry was leaving, Bolton slapped a soft, thick hand upon his shoulder.

"Youthful enthusiasm is a great thing," he said heartily. "A great thing. I like to see a young man with determination. But—but—I only hope this doesn't prove to be an expensive and unwise mistake."

On the Drumwell National's lease, the boiler made eager noises over its new fire. Jerry went about his preparations on the derrick floor with grim energy. He had sent Phil Medford, the tool dresser, up to oil the pulleys on the crown-block, some ninety feet overhead. His face was set, and there was a little anxious furrow between his gray eyes.

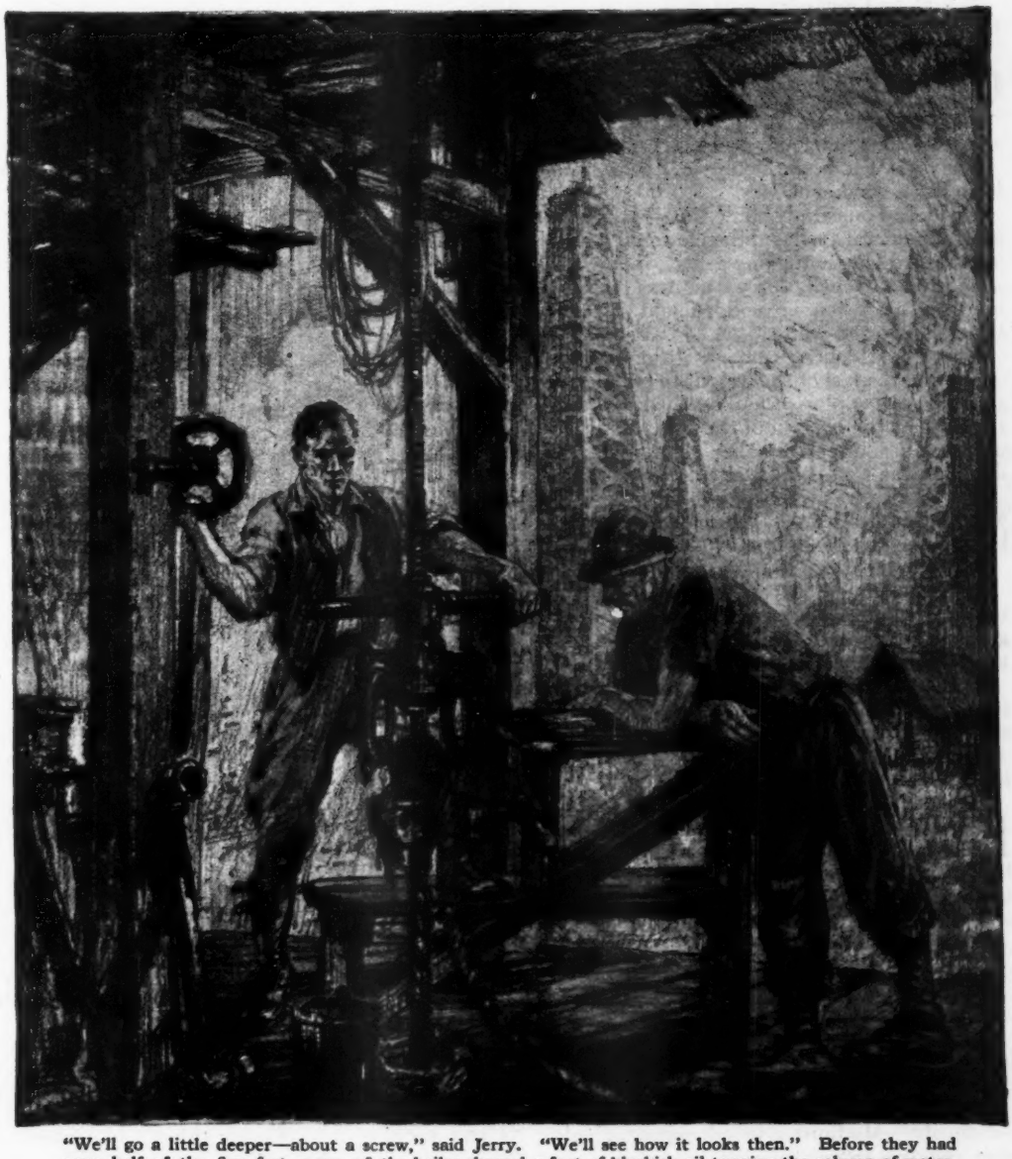
It was a hard job and a doubtful one that he had undertaken. He had spoken confidently of getting past an obstruction—wreckage, practically—that lay more than three quarters of a mile beneath the ground. Before he could cope with it, he must know the position of those unseen tools.

He tested the softness of a huge chunk of wax on the impression block which was to carry his sense of touch, almost his sight, to the bottom of the hole, and return stamped with the record of what lay there. As the tool dresser came down the ladder, Jerry was ready with the block attached at the lower end of the bailer—the man-high bucket which would weight and steady it. He swung it out over the mouth of the well and let it descend. The sand line to which it was attached ran swiftly, playing back and forth across the ten-inch diameter of the hole as the bailer and block dropped toward the bottom.

The story written in dents on that chunk of wax, as he brought it up after repeated tests, deepened the lines between Jerry's eyes. The tools, thirty feet long and of solid steel, lay with the top wedged inaccessibly against one side of the hole and the bit jammed into the other side.

FOR a little while Jerry wondered if Bolton had not been right after all—if the chances of finding oil in this wildcat well really were worth the effort of saving it. He sat down on the bench against the wall and pulled his worn notebook from his pocket. He studied the list he had made there of the different rocks and sands they had passed through, and compared it critically with the record of the upper formations in the rich pool to the south of Drumwell.

The comparison gave him heart. At the surface they first had gone through the same bed of red clay to a depth of about fifty



"We'll go a little deeper—about a screw," said Jerry. "We'll see how it looks then." Before they had gone half of the five feet, a run of the bailer showed a foot of blackish oil topping the column of water.

"What does it matter who I'm with?" Bleen demanded. "I want to buy the lease. I'm talking cash."

feet, and below that through corresponding layers of limestone, blue shale, sandy shale, sandy limestone, and so on. Reaching a depth of 1,570 feet, the bailer had brought up the same curious gummy blue shale—so sticky that it clung to the fingers and stretched out almost like taffy. Yes, if the story of the rocks meant anything—and to Jerry it did—then there *was* a chance, and a fair one.

When Medford came out of the engine house, where he had been working, Jerry stood up.

"That's all for today," he announced. "We'll get Curtis here tomorrow."

CURTIS was the best oil well "shooter" in the field. He drove up to the rig in his mud-spattered car, flaringly lettered "*Danger—Explosives*" and looking like a combination plumber's and telephone lineman's truck.

Jerry gave him the details of the well and said "Go ahead. Give her a good shot."

He looked on calmly while Curtis poured nitroglycerin into the long, slim metal shell and then lowered it into the well. Anxiously he watched Curtis tugging gently, inquiringly, on the line which supported the shell. Jerry's air was almost casual as he tried it himself, but when he nodded and stood back for Curtis, his knuckles showed white.

This was a delicate job. With only the measurement of the depth and the feel of the weight to guide them, they had to make sure that the explosive had reached the right position, alongside the tools at the bottom of the hole. Satisfied at last, the shooter dropped a squib—a smaller shell with a lighted time-fuse to detonate the first—and waited.

Jerry's face was worried, but eager now. His gray eyes glinted with the light of battle. If he could charge past that steel barrier, his argument with Bolton would be vindicated.

"There she goes," Curtis announced suddenly.

Unheard, unfelt, except by the shooter's trained senses, the bombardment had occurred. Somewhere underground, the nitroglycerin had loosed its smashing, tearing power. Whether it had taken effect upon the tools remained to be seen.

The faint acrid gas of the explosion had barely found its way to the open, and the shooter's car was scarcely out of sight, when the impression block was dropping into the hole again. Jerry worked anxiously. The sand line unwound and wound again on the spinning calf-wheel.

IT WAS dusk when the tests were concluded. Jerry smiled, but with gritted teeth, at the picture brought up by the wax block. Success was only partial. The blast had driven the tools to one side. The upper portion was clear, but the bit at the lower end still lay in the path of drilling.

"Well?" Medford queried.

"We'll start tomorrow," replied Jerry.

"Another shot, you mean?"

"No. Drilling."

"Through that there bit?" the tool dresser demanded incredulously.

"*By* it."

There was steel in Jerry's voice.

"*By* it?" Medford grinned appreciatively. "Can't nothing stop you, can there?"

The two men started toward town together in Jerry's battered roadster. A short distance from the well Jerry halted the car abruptly and slapped his hand on the wheel.

"I wanted to stop those leaks in the boiler line," he declared, "so we wouldn't be delayed tomorrow."

"How long'll it take? I'll go back with you."

"No. I may be a couple of hours." He looked down the road at the long distance Medford would have to travel to town. It was only a short walk back to the well. "You take the car," he said. "I may just roll up in that old bedding in the engine house and spend the night there."

"I'll drive back for you, later on."

"Never mind. You get some sleep, too."

Full darkness had come when Jerry completed his task. He rolled himself into the blankets. A soft wind, tainted by gas from the field to the south, brought the faint, lulling echoes of the engines pumping oil—and wealth.

IT WAS a moonless night. Most of the distant lights of Drumwell had been extinguished, when Jerry started up from his sleep. There was an auto on the road below the rig. Its silhouette was almost lost in the blackness of the hillside.

"Hello!" Jerry called sleepily. "Medford?"

No one replied.

There were brief, muffled voices, and the shadows near the car revealed the forms of two men who, apparently surprised at finding Jerry at the rig, hastily climbed back into the auto. The door slammed, the motor raced, gears sang out, and the car was gone.

Jerry peered after it. It had not carried Medford. The shadowed outline had been that of a closed model, not a roadster.

The identity and the mission of the prowlers had been hidden by the darkness, but thereafter the rig was never to be left unguarded.

* * * *

The fresh string of tools gleamed in the sun as they started into the well. Thirty-odd feet of smooth, gray steel, eight inches through, they gave off a heavy, solid *clink* as they scraped the side and slipped swiftly out of sight. The huge spool-like bull-wheel whirled as the steel cable sped from it up to the pulleys in the crown-block and down into the darkness of the well.

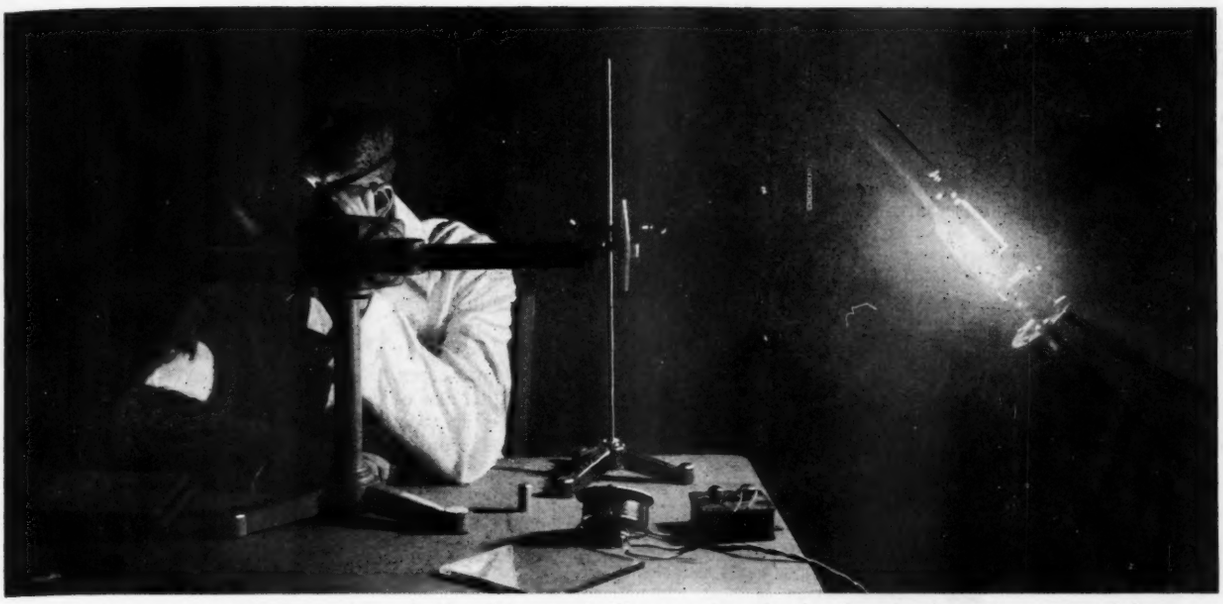
Four thousand feet of line spun out, and the tools were at the bottom. Then the walking-beam was moving, like a giant see-saw, with its heavy arm made fast to the cable above the well. Jerry watched it lifting and dropping the line, its rise and fall marking time while the three tons of tools beat their smashing rhythm, unheard, in the earth below.

HE GRASPED the cable, getting the feel of the distant impact. This was not an ordinary drilling job. His tools down there were pounding upon another bit, as hard as they, virtually impenetrable. Progress could be made only as the obstruction was shoved to the side, or as the blows glanced off and dug their way angularly by it.

It was tedious work. The rise and fall of the walking-beam counted off hours. Then days. Finally weeks.

Jerry stood, meditatively tapping a folded letter in the palm of his hand.

"Funny thing," he observed to Medford. "Friend of mine back East says some fellow has been (*Continued on page 148*)



A scientific use of photography that is as valuable as it is unusual. The camera is employed to determine the exact percentage of ultra-violet light (which is invisible to the human eye) that passes through a specimen of special glass manufactured for use in experiments.

New Magic Worked by Cameras

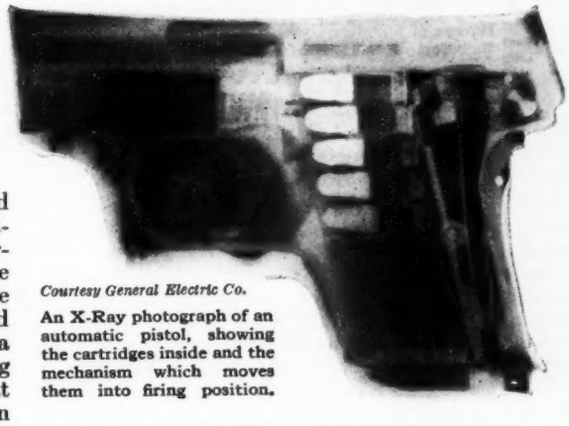
Amazing Modern Photography Solves Problems of Science, Industry, and Athletics, and Even Settles Legal Disputes

By ELLSWORTH BENNETT

IN A California court the other day, Capt. W. B. Sellner, State Fish and Game Commissioner, accused a man of trespassing and dumping garbage on his property. Vigorously the other protested his innocence. The court was puzzled.

"One moment, Your Honor," said Capt. Sellner. "I can show you first-hand evidence." With the court's permission he tacked a bedspread on the wall and produced a roll of film made with a home movie camera. A second later, judge and culprit saw a movie of a man caught in the very act of dumping garbage—blissfully unconscious that an all-seeing camera was focused upon him, recording every movement. "Guilty!" said the judge.

Many the lawsuit that has been decided, as in the case above, by a photograph, such is the reputation of the modern camera as an eye that sees every detail and does not forget. But today's camera can do more than that. Science and industry alike know it as an ally. It can photograph things that no human eye can ever see. It can picture lightning, study the explosion of blasting powder, slow up for human eyes the crash of an airplane into a concrete wall. So fast are cameras that they can capture an event that is over long before you realized it was going to happen. So sharp is the camera's eye that it can peer through solid metal.



Courtesy General Electric Co.

An X-Ray photograph of an automatic pistol, showing the cartridges inside and the mechanism which moves them into firing position.

THE MAGIC EYE

IN 1839 there was only one camera in the world. The story that begins with Daguerre, a scene-painter for the Paris Opera, and his "tintypes," and ends with the wonders of modern photography, is related in this dramatic article.

An image flashes upon the eye and vanishes. It flashes upon a film and remains forever. How such films have helped us study the stars, discover unsuspected things about the lightning, even led to the discovery of an entirely new chemical element, is related here. Everyone who owns a camera or has taken pictures will be interested.

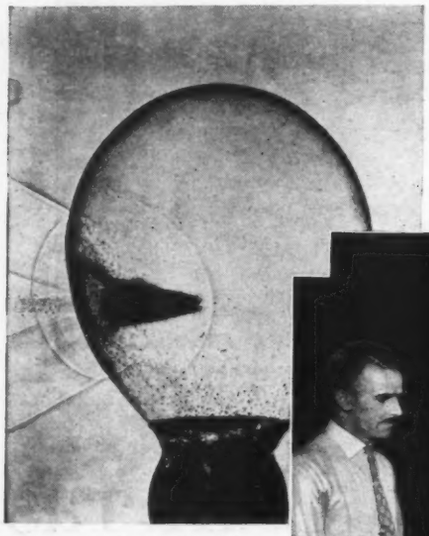
Today anyone can buy a camera that will take a photograph in the incredibly brief time of a thousandth of a second and "freeze" into stark immobility racing automobiles and leaping athletes. Specially built cameras perform wonders greater than these, and catch the jagged, twisting forks of a streak of lightning—the speeding flight of a rifle bullet—or the flying droplets of a splash of water stopped in mid-air.

ALL these are things that science would like to know more about, and is studying with the aid of the camera. No bolt of lightning is fast enough to escape the swift camera that J. W. Legg, research engineer of the Westinghouse Electric and Manufacturing Company, designed and built. A gleaming, polished metal mechanism studded with twenty-two glass lenses, this instrument has no counterpart in the world. Its two revolving shutters take 2,600 pictures of electric flashes in the laboratory each second. When Legg trained his camera on huge sparks, he found for the first time that artificial lightning—and natural lightning, too, it may safely be assumed, for both are simply great electric sparks—actually travels, not in zigzag or in straight lines, but in spirals. He had caught real moving pictures of the corkscrew-twisting sparks; and had demonstrated the

value of his instrument for studying the behavior of high-voltage currents, important in power transmission.

Just as these sparks furnished their own light to the photographer, electric flashes replace inadequate daylight or ordinary electric light for super-speed pictures.

Extraordinarily ingenious arrangements have been made so that speeding bullets break an electric wire in their flight and take their own "flashlight" picture by the resulting spark. And an English experimenter, Worthington, took the first successful photograph of a splash of water in all its stages by suspending two metal balls by magnets so wired that a single electric switch would release both balls at once. The first, dropping into a tub of water, made the splash; the second, falling past the terminals of an electric condenser, released a spark that took the instantaneous picture. By altering the timing of the spark through changing the distance the second ball had to fall, he photographed at will the beginning, middle, and end of the splash.

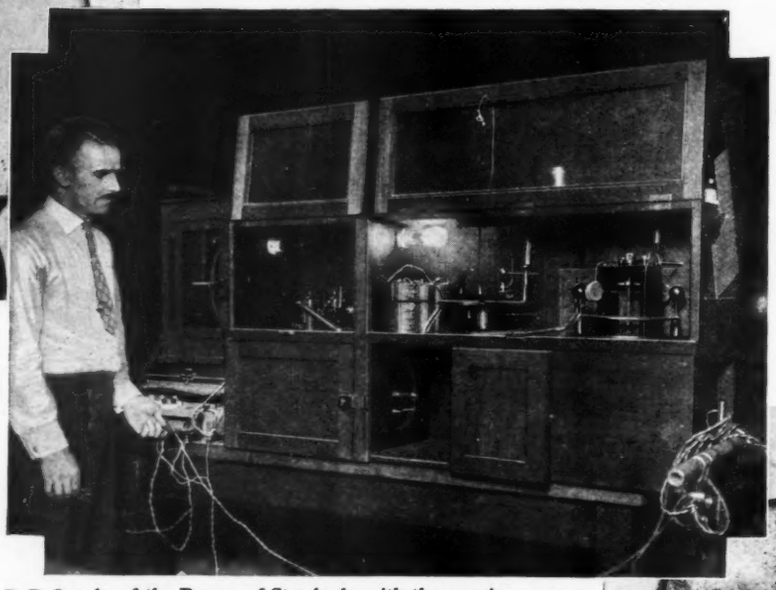


Photograph of a bullet flying 2,700 feet (more than half a mile) a second entering a soap bubble which is filled with a mixture of nitrogen and air.

How safe an explosive will prove for use in a mine is determined, now, by taking a speed photograph of its flame. The height of the flame from a measured charge of blasting gelatin or powder, impressed on a moving film that bears a graduated scale, shows just how soon after ignition the explosion reaches its height, and how far the flame has spread. A "permitted" or "safe" explosive gives a small flame and is completely burned in a tiny fraction of a second.

MOST of us have seen "slow movies," generally intended purely for amusement, that are produced when a film projected at standard rate has been taken much faster. Fast runners become models of slow, graceful action; an athlete seems to float over a hurdle, and a leaping horse soars gently over a barrier, to rebound as if shod with rubber. American trainers were among the first to use such films to find out what was wrong when promising young athletes failed to show expected excellence. And in hurdling, for example, the camera has revealed how the American Simpson, and later the Canadian, Earl Thompson, were able to achieve "impossible" new marks that finally brought a fifteen-second record for ten hurdles in 120 yards down to $14^2/_5$ seconds. Both men had a trick of raising the knee of their trailing leg to shoulder height to clear the bar, so speedy as to pass unnoticed to visual observers, and probably not even fully appreciated by themselves.

New secrets of the birds' flight, one of the longest standing mysteries of science, may give way at last to the latest wonder camera, brought to this country by the Japanese expert Baron Shiba. That is the use one noted engineer, Elmer A. Sperry of gyroscope and airplane beacon fame, sees in the camera that takes 20,000 pictures a second. Designed for research in aeronautical design, it is expected to disclose new facts about air streams from propellers and air currents around the wings of a plane. It makes a spinning propeller look like a slow-revolving door, and a bullet whizzing through air like an idly-drifting black chip.



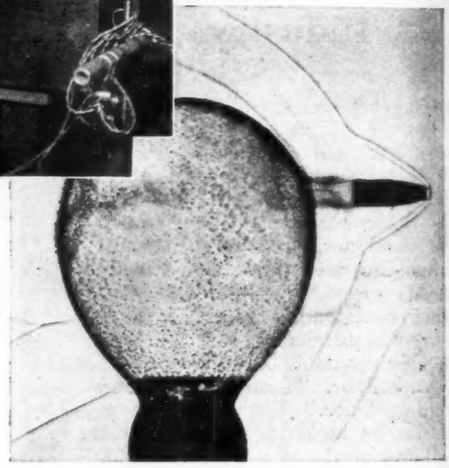
P. P. Quayle, of the Bureau of Standards, with the amazing camera with which he made the accompanying photographs of a flying bullet.

WHAT happens inside a Diesel engine may now be studied through the use of a new photographic device that takes 4,000 pictures a second, each one in a millionth of a second's time, according to W. F. Joachim, head of engine research for the Advisory Committee of Aeronautics at Langley Field, Va. A camera designed to study the explosion and burning of fuel as it is sprayed into the motor's cylinders at high pressure is attached to the combustion chamber to take a picture through heavy plate glass; a high-tension electric spark provides light. Ten pictures have been taken, Joachim says, that show the complete spraying operation.

A ten-thousand-picture-a-second camera developed for the British Admiralty has shown the actual penetration of huge armor-piercing shells into hardened steel targets. Imagine the consternation had one shell gone astray and wrecked this priceless mechanism!

Not long ago, at McCook Field, Dayton, Ohio, a number of condemned airplanes were sent crashing at full speed against a concrete wall to determine just where fire breaks out in a plane's motor after a crash, so that improved engine design would decrease the hazard. Ultra-rapid movie cameras photographed the planes being wrecked; and films made at eight times normal speed, developed and run over again slowly, revealed the source of fire danger.

THESE are examples of the pictures taken at terrific velocity that reveal, when slowed down, surprising facts about people and machines. Reversed, the process has equally fascinating possibilities. Pictures of things as slow as the growing of a plant have been taken on a continuous reel of film, each time from the same position, at intervals of, say, a day; and later shown as a continuous "movie" in which the whole action of months is condensed into a fraction of a minute. Such pictures are a revelation of the way a plant really grows; they show its extraordinary contortions as, rooted to one spot, it writhes, twists, and unfolds.

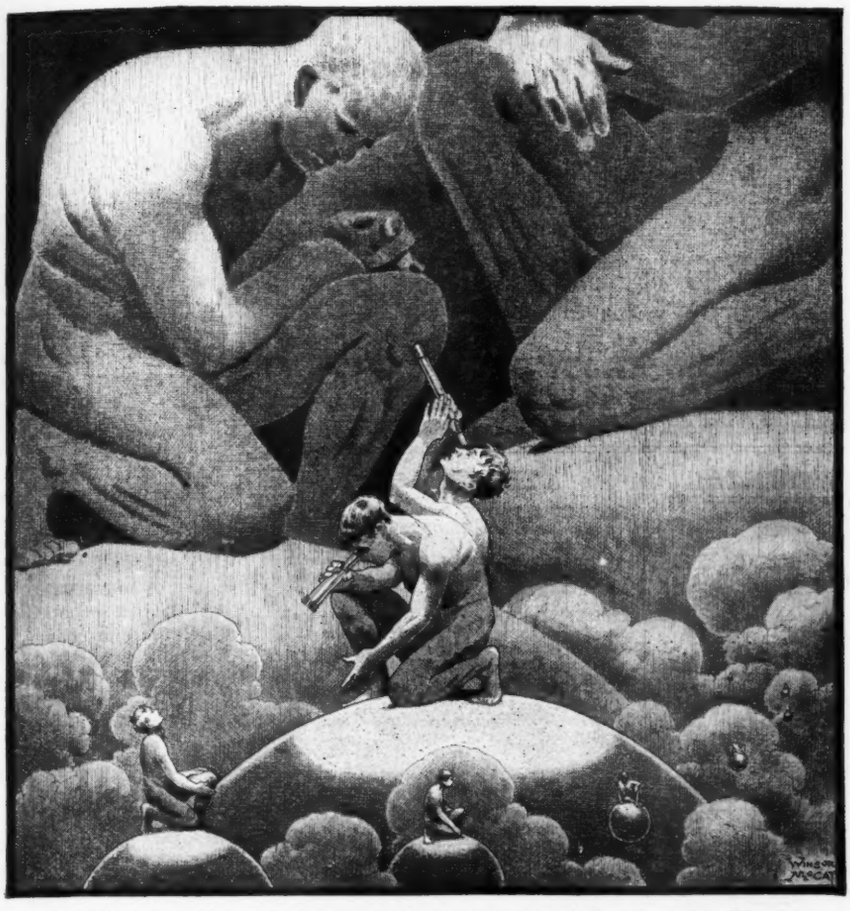


The .30 caliber bullet emerging from the bubble it is seen entering above to the left.

Following the same plan, Prof. R. J. Terry and two assistants at Washington University recently attempted to prepare a "fast movie" of hair growing on a man's chin after a shave, photographing exactly the same spot of skin through a powerful microscope every two hours for four days. Though it failed as a "movie," because the subject's skin stretched and jerked the hairs about between the exposures, the picture made a valuable record of the speed of hair growth.

Nor are nature and anatomical studies the only ones where "fast movies" are of value; it is equally possible to photograph, step by step, the building of a bridge or a skyscraper, says (*Continued on page 138*)

Is Man Pygmy or Giant?



It all depends on the point of view—whether you look through the telescope or through the microscope. In this inspiring article a noted educator, a member of the faculty of the College of the City of New York, reveals how man, standing between two infinities —the large and the small—and mastering the laws of both, has risen above insignificance.

He Has Made Himself Master of the Earth, Yet in the Universe He is Merely a Speck

By

WILLIAM BRADLEY OTIS

SOME weeks ago astronomers announced that a star, Nova Pictoris, apparently had split in two. The spectacle, described recently in POPULAR SCIENCE MONTHLY, was offered as a remarkable new discovery. Yet the actual event had occurred sixty years before Christopher Columbus was born! It had taken all the time since for the fastest messenger known to man to bring us the news. The distance between the earth and this star is so great that it took five centuries for a ray of light, traveling at more than 186,000 miles a second, to bridge the gap.

When we stop to consider that for a moment, we begin to wonder about man and his place in such a vast universe. Is he a pygmy or is he a giant? To find out, let's first look at the universe around us.

Pick out the fastest thing you know. The hurricane? It goes a hundred miles an hour. The locomotive? It goes a hundred and twenty. The racing automobile? It goes two hundred and six. The airplane? It goes three hundred and fifty.

They are all too slow! Ride a beam of light. It travels so fast that it can circle the globe eight times while you draw a single breath.

Are you ready? Go! Speeding into space at the rate of 186,000 miles a *second*, it takes you three and a half years to reach the nearest star. It takes you twenty-two years to reach Sirius. It takes you more than seventy to reach Capella, and your journey is just begun!

You will travel for six hundred *centuries* before you come to a far star on the borderlands of the Milky Way, and for more than a thousand centuries before you reach the most distant star we know.

Long before the dawn of history, even before the coming of the first Neanderthal man, this last star may have disappeared from the sky. Yet we see it still! The light rays that we see tonight left it more than 100,000 years ago. The ones starting today will be seen on earth a thousand centuries hence, after thousands of generations have come and gone. What sort of people, living in what sort of a civilization, will see those rays? An interesting question.

IF LINDBERGH hopped off for Mars in his airplane and flew at top speed all the way, before he reached the planet he would be an old man of seventy and over!

The dot on this "i" looms immeasurably larger on this page than does our earth in the universe. And on this earth speck lie the pride of man's handiwork—his cities, his skyscrapers, his factories, and his railways.

In the vast stretches of such a universe, what a pygmy seems man!

ONE individual is lost to sight in a great city. And that city, on a map of the world, appears smaller than a speck of dust on the side of a circus elephant. And that world, in the universe, is like a drop of water compared with the wide Atlantic. And beyond that universe, for all we know, stretch super-universes in which the distance from earth to our farthest star will look like a sixteenth-inch mark on a surveyor's long steel tape!

An idea of the staggering size of the universe was given the other day by Prof. Edwin B. Frost, director of the Yerkes Observatory at Williams Bay, Wis. If you hold a dime at arm's length toward the Milky Way, he said, the coin will hide about fifteen million suns! A single photograph including less than one-thousandth part of the night sky revealed images of about 400,000 stars. The far-distant star Antares appears through telescopes as a tiny speck in the heavens, yet it is forty million times as big as our sun.

In the last thirty years, discoveries of astronomers have extended the boundaries of space ten thousand times.

Thus, looking up and out from his planet, man feels himself grow smaller and smaller. He sees written in capital letters the story of his own unimportance. In such a universe, what a pygmy he is!

BUT, looking in another direction, he reads another story. It is the most fantastic, incredible tale science ever verified. It tells him that he is a giant, a colossus, who walks on universes, who holds a million whirling suns and satellites in the hollow of his hand, who brushes a solar system into space and calls it a speck of dust!

It tells him that the very telescope with which he studies a universe so vast it makes him dizzy is made of little universes so small he cannot see them. The metal tube of his instrument, and the very glass through which he peers, is formed of solar systems whirling in ceaseless activity.

When you turn this page and feel the paper between your thumb and finger, you know that its thickness barely separates them. Yet for that short distance—about one-six-hundredth of an inch—300,000

(*Continued on page 135*)

Air Time-Tables Now Make Flying Trips Easy

By George Lee Dowd, Jr.

AT NINE in the morning, not long ago, a San Francisco business man hurried down the gangplank of a liner just docked in New York. He was racing home from abroad to the bedside of a close relative, critically ill; a New York friend, notified by cable, had arranged his passage across the continent.

Twelve-fifteen and he was on a mail plane leaving New Brunswick, N. J. And at four-thirty the next afternoon he was in San Francisco, having made in scarcely more than a day a trip that takes four days by the fastest trains.

That was no specially arranged race against time—but the regular schedule, seven days a week, of two of the thirty-two air passenger lines operating today in the United States. Other journeys by air are as speedy; and last year more than eight thousand persons saved time and money by traveling the air way.

Many more persons did not go by air. A large percentage of them hadn't the faintest idea how to go about it; to them, airports were something vague and indefinite away off on the outskirts of a city, while railway terminals were near at hand. Too, aviation has become shrouded in a sort of optimistic halo that has overshadowed its striking, genuine progress.

FOR this reason, Popular Science Monthly recently undertook a nationwide survey to find out exactly where air passenger travel stands in the United States today—a fair, impartial investigation that sought not hopeful dreams, but practical facts on the airplane's usefulness in fast business, pleasure, and emergency travel. Its results follow.

Here is a typical case. From Seattle to San Francisco is an afternoon, overnight, and all-day trip on the *Cascade*, crack train of the Southern Pacific Railroad. The rail trip costs $33, exclusive of extra fare required on this twenty-eight-hour train. For $55 you can board a West Coast Air Transport cabin airplane at Seattle, and arrive in San Francisco in less than eight hours after a trip of unparalleled scenic grandeur. Another line, the Pacific Air Transport, duplicates the trip and adds a buffet meal in the air.

Los Angeles to Tucson, Arizona, is an $18.50 overnight or an all-day trip by train across miles of burning country. Six-passenger Fokker monoplanes of the Aero Corporation of California make the journey in six hours at a fare of $40.

IN THE East in summer the Colonial Air Transport adds to its regular New York-Boston mail route Fairchild cabin monoplanes for passengers. It charges $25 for the three-and-a-half-hour voyage which would cost you eight dollars, plus extra fare, by a five-hour train.

From a thorough analysis of examples such as these, from every part of the country, several outstanding important facts about air travel are apparent.

In general, it is nearly three times as fast as rail and costs about two and a half times as much, except on parts of the New York-Chicago-San Francisco transcontinental trip where the time saving is even greater than on shorter journeys and the air fare is proportionately higher.

The West is dotted with air passenger lines. Los Angeles and San Francisco, thirteen hours apart by train, are connected by a five-hour air trip in the Western Air Express's twelve-passenger Fokkers. From Los Angeles it is a one-hour trip to San Diego via the

CONSOLIDATED AIR PASSENGER TIME-TABLES

All service daily except where otherwise indicated

TRANSCONTINENTAL

Westward (read down)	(*National Air Transport. Emergency passenger service**)			Eastward (read up)
12.15 (ET)	Lv	**Hadley Field, N.J.** †	Ar	4.45
4.20	Ar	**Cleveland**	Lv	12.15
4.35	Lv	**Cleveland**	Ar	(ET) 12.00
5.20 (CT)	Lv	Toledo	Lv	9:50
7.00	Ar	**Chicago**	Lv	8.00
		(*Boeing Air Transport*)		
7.50	Lv	**Chicago**	Ar	5.45
9.40	Lv	Iowa City, Iowa		.....
.....		Des Moines, Iowa	Ar	1.30
12.20	Ar	**Omaha, Neb.**	Lv	12.30
12.35	Lv	**Omaha, Neb.**	Ar	(CT) 12.15
2.50	Ar	**North Platte, Neb.**		.....
3.00	Lv	**North Platte, Neb.**		.....
4.30 (MT)	Ar	**Cheyenne, Wyo.**		7.30
4.45	Lv	**Cheyenne, Wyo.**		(MT) 7.15
7.05	Lv	Rock Springs, Wyo.		.....
10.00	Ar	**Salt Lake City, U.**	Lv	2.05
10.20	Lv	**Salt Lake City, U.**	Ar	1.45
11.15 (PT)	Lv	Elko, Nev.	Lv	11.00
1.30	Ar	**Reno, Nev.**	Lv	9.00
1.45	Lv	**Reno, Nev.**	Ar	8.45
2.45	Lv	Sacramento, Cal.	Lv	7.45
4.30	Ar	**Oakland, Cal.**	Lv	(PT) 7.00

*One passenger transported daily, in open mail plane, subject to weather conditions and loading. Additional passenger service to be provided soon.
†Terminal subject to change.

NEW YORK-BOSTON

(*Colonial Air Transport. Summer passenger service, daily except Sunday*)
Eastern Standard Time

To Boston (read down)			To New York (read up)
5.00	Lv	**Hadley Field, N. J.** Ar	9.15
6.30	Ar	**Hartford, Conn.** Ar	*7.35
8.05	Ar	**Boston** Lv	6.15

*No passengers carried from Hartford to New York until Newark, N. J., airport available.

TERMINALS

HADLEY FIELD, N. J. Transcontinental passengers from New York via 10.15 AM Pennsylvania R. R. train, changing at Newark for Stelton (flag station near New Brunswick, N. J.); thence by N. A. T. auto to field.

OAKLAND, CALIF. Transcontinental passengers from San Francisco via 6.15 AM Southern Pacific ferryboat to Alameda, thence by Boeing auto to field.

CHICAGO (Municipal airport at Cicero). Passenger furnishes own transportation to or from loop district; allow 1½ hours by street car, "L," or motor.

CONNECTIONS

AT CLEVELAND: Detroit via Stout Air Service. (Except Sunday.)
Albany and Buffalo via Colonial Western Airline. (Except Sunday.)

AT CHICAGO (Municipal Airport): Kansas City via Nat'l Air Transport.
Minneapolis via Northwest Airways. (Except Sunday and one-way Saturday and Monday.)
St. Louis via Robertson Aircraft. (Except Sunday, Monday, holidays.)
Cincinnati via Embry Riddle Co.
Memphis via Mid-South Airways.

AT CHEYENNE:
Pueblo, Colo., via Western Air Express.

AT SALT LAKE CITY:
Los Angeles, Calif., via Western Air Express.

NOTES

AM time is shown in light face figures; **PM time in bold face figures.**

(ET) means Eastern Time; (CT), Central Time; (MT), Mountain Time; (PT), Pacific Time. All time shown is Standard Time, one hour earlier than Daylight Saving.

These tables subject to change without notice.

SEATTLE-SAN FRANCISCO-LOS ANGELES†

(*Pacific Air Transport, daily except Monday; West Coast Air Transport, daily except Sunday and as noted*)
Pacific Standard Time

Southbound (read down)							Northbound (read up)		
PAT	WCAT	PAT	WCAT				WCAT	PAT	WCAT
.....	8.30	2.00	4.00	Lv	**Seattle**	Ar	8.15	*2.00	3.45
.....	8.45	s	4.15	Lv	Tacoma	Ar	7.50	*1.30	3.30
.....	9.05	.....	4.35	Lv	Chehalis	Ar	7.30	.....	3.00
.....	9.45	4.00	5.15	Ar	**Portland**	Lv	7.00	11.30	2.30
7.00	a10.00	.....	.....	Lv	**Portland**	Ar	.....	.....	b 2.15
.....	a12.30	.....	.....	Ar	**Medford**	Lv	.....	.....	b11.45
9.30	a12.45	.....	.....	Lv	**Medford**	Ar	.....	9.00	b11 30
.....	a 2.45	.....	.....	Lv	Corning	Ar	.....	.....	b 9.30
1.15	a 4.15	.....	.....	Lv	**San Francisco**	Lv	.....	5.00	b 8.00
3.15	.....	.....	.....	Lv	Fresno	Lv	.....	E3.00	.....
4.45	.....	.....	.....	Lv	Bakersfield	Lv	.....	E1.30	.....
6.15	.....	.....	.....	Ar	**Los Angeles**	Lv	.....	E12.01	.....

s Stops only by special arrangement. *By rail from Vancouver (Portland).
E Passengers not flown at night, Los Angeles-San Francisco, except in emergency.
a, Monday, Wednesday, Friday, only. b, Tuesday, Thursday, Saturday, only.

Passengers boarding a National Air Transport plane at Kansas City for the 500-mile trip to Chicago in a Travel Air machine.

Field manager (right) checking passengers into a cabin monoplane for a flight that will take them to Kansas City in 5 hours.

Maddux Air Lines; the fare is $15. This is a passenger line exclusively. With its recent extension to San Francisco, four lines now connect that city and Los Angeles.

The Midwest, too, has its air routes. Chicago is the hub of a whole series of radiating airlines; one, for instance, Northwest Airways, runs planes to Minneapolis in five hours, while the *Viking*, pride of the Northwestern Railway, takes eleven hours to make the same trip. You can breakfast in Chicago and lunch in Memphis, Tenn., via the new six-hour $100 service of the Mid-South Airways.

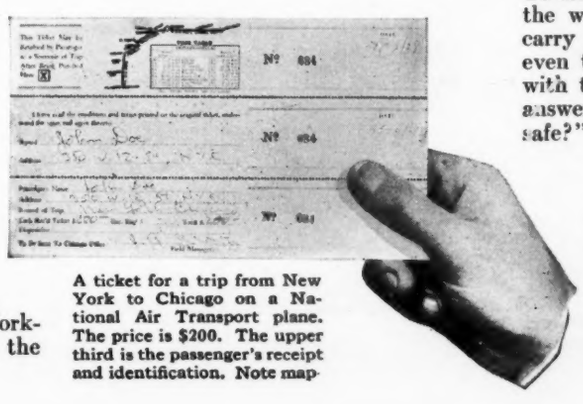
What has the East to compare with these lines? Besides its part of the transcontinental route, it has the New York-Boston airway—and that is nearly all!

THE Colonial Western Airways connect Cleveland and Albany. The St. Tammany Gulf Airline, which flies the daylight part of the New York to New Orleans mail route, accepts passengers between Atlanta, Georgia, and New Orleans. Planes of the Pan-American Airways fly between Key West, Fla., and Havana, connecting with the Havana Special train from New York.

That is the best the East can do today, but it is going to do better. Airlines are proposed between New York and Washington, and by the time this article is published one may be in operation between Washington and Norfolk, Va. The cross-country line to Chicago, now an "emergency" service, is to be vastly improved upon.

A new airport at Newark, N. J., will give New York half-hour connection with cross country airlines. One of the first to use it will be the newly announced New York-Montreal air passenger service of the Canadian Colonial Airways.

Short air trips are as practical as long ones; and every important stopping point along a through airline has "feeders" or local connecting lines that serve it. Thus from Cleveland, on the transcontinental airway, you can go to Detroit in three and a half hours by the Stout Air Services, running two roomy cabin planes daily; and to Albany and Buffalo by way of the Colonial Western Airways. Chicago has connections to Cincinnati via the Embry Riddle Company's planes; to St. Louis via Robertson Aircraft; to Kansas City over the National Air Transport's route; and to Memphis and Minneapolis by air lines already mentioned. At Cheyenne, Wyoming, the Western Air Express' planes provide a trip to Pueblo, Colo., and the same company connects Los Angeles with the transcontinental line at Salt Lake City, Utah.



A ticket for a trip from New York to Chicago on a National Air Transport plane. The price is $200. The upper third is the passenger's receipt and identification. Note map

IN MANY states, too, short inter-city trips by air are or will be regularly scheduled; thus Oklahoma, for instance, has a statewide passenger air service operated by the Oklahoma Air Transport Company and another Tulsa-Oklahoma City air line. Other states, notably Michigan and Texas, are blanketed with air lines.

Timetables of the Cleveland, Southwestern Railway and Light Company announce that the railroad's ticket agents will sell tickets on the Stout airline between Cleveland and Detroit, probably the first recorded instance of a railroad selling air tickets. In this case, the air field is near the Cleveland station. Generally airports are more remote; and some air transport companies provide buses or cars to transport passengers from the nearest railway station to the field.

Today's air lines are regularly scheduled services; hence the "air time-tables" we are able to present with this article. To some extent they are dependent upon the weather; many mail lines will not carry passengers if weather threatens, even though the pilot may go through with the mail. This is one of the best answers to the question, "Is air travel safe?" In many places it is developing with almost painful slowness, so cautious are transport lines to make sure that it will be safe. And over all but the best-lighted airways, no air line will carry passengers at night; though the air mail goes through with practically unfailing regularity.

"Air taxi" service at any large

(*Continued on page 124*)

Is Oil Burning *Too* Costly?

More Comfortable and Convenient, Certainly, But This Article Weighs the Problem as It Affects Your Purse

By JOHN E. LODGE

IS THE added comfort and convenience of an oil burner worth the price? That question today confronts every prospective home owner. The answer, of course, depends on the value you put on the advantages of oil heating, and other factors that must be considered in contrasting oil with other fuels.

The oil burner is, after all, only a highly perfected mechanism for producing heat. And, without an efficient heating plant to transfer that heat to the rooms in your house, the oil burner must work under a severe handicap.

Theoretically, a ton of coal equals in heat value from 190 to 215 gallons of oil. But it is one thing to determine the theoretical heat value of a fuel and quite another to find out how much heat is actually used. Your heating plant, not the fuel, determines that, whether you burn coal or oil.

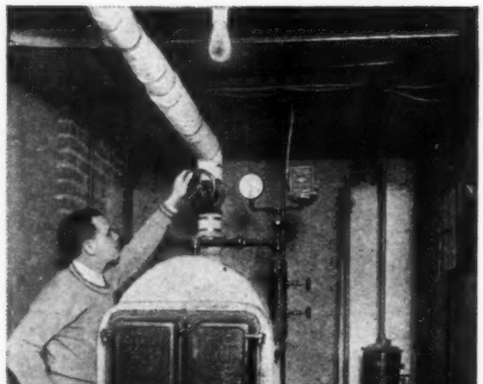
Burning fuel produces heat in two ways, the hot gases and the radiant heat from the red-hot lumps of coal and the flame. A good boiler absorbs the largest possible amount of both kinds of heat. The rest is wasted up the chimney.

A boiler that gives good results with coal may not do as well with oil. The two fuels do not burn alike. Coal, most of the time, is burned with a reduced draft, whereas the mechanical draft oil burner always runs full blast.

An inefficient boiler, one with inadequate heating surface, may give fair results with coal because the coal is burned slowly, permitting the surface in the boiler to absorb a fair percentage of the heat. An oil burner under such a boiler will blow most of the heat up the chimney.

INVESTIGATIONS of the Popular Science Institute of Standards have shown that when oil heating costs too much, the trouble nearly always is due to an inefficient boiler. This means, in short, that if you have an inefficient boiler your coal bills may be higher than they should be, but if you install an oil burner you will be even more heavily penalized.

But you must not get the idea that the boiler installed in the average home is so poor that it won't work with an oil burner. That isn't so, because even if the boiler is below par it can be improved by adding sections to give more heating surface. And a good oil burner used in conjunction with a good boiler always produces more heat than would appear theoretically to be possible.



An ideal oil-heated boiler. Shutting off the main supply to radiators so that the plant may be used during the summer solely to provide hot water.

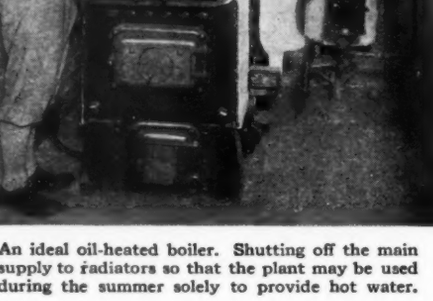
That is because during fall and spring and every warm spell the oil burner shuts down and uses no fuel. A coal fire, at such times, keeps right on burning coal.

Reports received by the Institute from oil burner owners prove these points. Here is one from a man in New Rochelle, New York, that shows what oil heating will do under a good boiler:

"In 1925 I spent $204.75 for coal. In 1926 the bill was $157.50. During both these winters I paid a furnace man $15 a month to take care of my furnace or a total of $120 a year. I began to burn oil March 1, 1927, and from that time until June 15, 1928, I have used 2,832 gallons, which cost me $240.31. Now when you stop to consider that this figure covers the cost of heating my home through an entire winter and, in addition, kept us supplied with all the hot water we could use for a year and a quarter, making it unnecessary to burn any gas for hot water heating, I think you will agree that I'm getting the luxury of oil heating at a pretty low figure."

The photograph shows this particular installation. A heating coil is connected to the hot water storage tank so that during the winter the water is heated as in any similar installation. When summer arrives the owner merely shuts off the main supply pipe to the radiators upstairs by means of the large valve. A switch is thrown to connect the oil burner control to a different thermostat so that it will run the main boiler only enough to supply hot water to the hot water storage tank.

The excellent results described are obviously due to the modern, amply large and efficient boiler used.


MOST OF HEAT GOES UP CHIMNEY
MORE BOILER SECTIONS ADDED WOULD IMPROVE RESULTS
TOO LITTLE SURFACE EXPOSED TO FLAME
FLAME FROM ANY TYPE OF OIL BURNER

This diagram shows an inefficient oil burner installation that results in large expense and suggests an improvement that would save money.

HERE is a report from an oil burner owner in South Carver, Mass.

"In the winter of 1926–1927 I burned about twelve tons of hard coal at $17.75 a ton, a total of $213.00. This winter, from October 15 until April 11, I used 1,920 gallons of oil, costing, at ten cents a gallon, $192.00. Probably before summer my oil will have cost me about the same as the coal, but I have received much more and better heat. I keep an average temperature of seventy degrees to seventy-five degrees in my house all the time. With coal it was from sixty degrees to seventy-five degrees." And now comes a very significant statement, "The heating plant now requires no attention at all and I would not want to go back to coal again."

This particular owner has his oil burner installed under a boiler that is quite old, but it is of adequate size with plenty of heating surface. The high price of both the coal and oil he has used undoubtedly is due to his location.

And to show what happens when the boiler is inadequate, note this report from a doctor who has a large house in St. Louis, Missouri:

"I find that I used for three years with the old boiler a little over 6,000 gallons of oil fuel a year. For the year just past I have used about 4,500 gallons and have had hot water automatically supplied throughout the summer, so you can see what can be accomplished by installing a really good boiler."

Tips *from a* Veteran Carpenter

Secrets About the Selection and Use of Materials That Will Save You Money When You Build Your Home

By JOHN R. McMAHON

"WHAT advice would you give a greenhorn on building a house?"

"That's a fine question!" snorted Uncle Ed Warner.

"In what way, if you don't mind telling?"

"Every which way. It's like asking what advice a landlubber needs to become a navigator. Kind of a lifetime job, seems to me."

"You're right as usual, Uncle Ed," I assured the old man. "Still, there are some special tips a veteran like yourself might give to a beginner. Something that isn't in all the books and that you have dug out of your long experience in building."

"Maybe so. Wait till I carve this plug and get my pipe loaded. Let me tell you that smoking tobacco these days—"

While Uncle Ed labors to stoke his dudheen in his own deliberate and silent fashion, I have a chance to inform the reader that this man is the wisest carpenter in our town. He has first-class tools and keeps them sharp and shining. He uses a steel square to do things that a mathematician would need half a blackboard to express. His pet saw is two inches wide, having been ground down to that narrowness by decades of honorable service. It has sawed carloads of lumber, including species of trees now virtually extinct, and might be considered the owner's postgraduate diploma and proof of master craftsmanship.

"Well, I'll tell you something that isn't in all the books," resumed Uncle Ed when his pipe was drawing satisfactorily.

"Go ahead and just imagine you're talking to the rawest greenhorn," I encouraged.

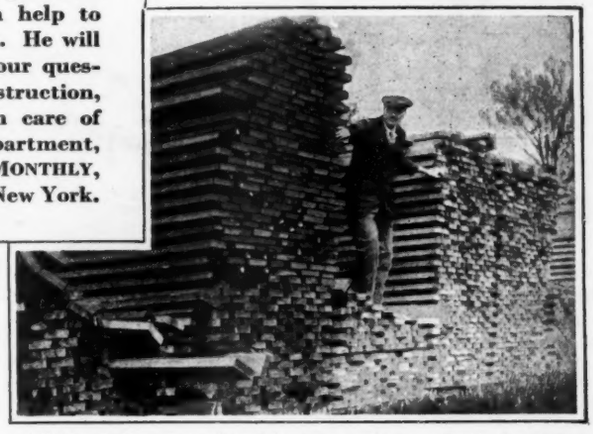
"It's the question of using seasoned lumber in a house. If you build a house with well-seasoned lumber, it stays tight and solid for several lifetimes. I've seen many old Colonial houses of that kind. On the other hand, houses built just a few years ago are full of cracks and loose joints that would take a barrel of putty to close up. Besides the looks, wind and weather go through the cracks and start the ruin of the building. The owner has to tinker and patch everything, and he sometimes blames the carpenter for the rank open joints that appear after a few years, when they are just due to the use of green lumber that has dried out and shrunk."

"Methods of seasoning lumber have been changed quite a bit since the old days," I observed, as Uncle Ed paused.

"Yes. Time was when a tree was cut down a couple of years before it was sawed into lumber and that lumber was kept in a pile for air drying another two or three years. The stuff was seasoned right in that way. The scheme nowadays is to hustle a log from the woods to the mill, turn it into boards, shoot them into a high temperature kiln for two days, and then pile them into a car for shipment to some local dealer. You buy the boards that were part of a living tree a few months ago. They have so much sap and life in them it's a wonder they don't sprout on your house."

UNCLE ED chuckled. "Willow siding that began to grow would be pretty neat along with mossy shingles. I won't charge anything for the idea. Well, the fact is that the ordinary kiln-dried lumber is not more than half dry or seasoned. It keeps on drying when put in a building and it shrinks and shrinks. I guess you know that

EVERY man who builds, buys, or remodels a home occasionally runs into difficulties. Mr. McMahon's practical articles each month help to solve these problems. He will be glad to answer your questions on home construction, addressed to him in care of Homebuilding Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.



Which of these two piles of lumber would you choose for your house? Take the old black stuff in the pile at the left, advises the veteran carpenter; it is well seasoned and will not shrink or warp.

In any lumberyard, the best lumber is the dark, dirty, weather-beaten layer at the bottom of the pile. The bright new "green" material at the top is likely to shrink and warp.

This modern Colonial house will live to a ripe old age because the wood in it, as in its old predecessors, was well seasoned against shrinkage.

shrinkage is crosswise of a board or beam and not lengthwise to any extent. Warping is another trouble of green lumber, especially the flat grain stock; it is a first cousin to shrinkage, but not the same. Now we can allow for shrinkage in the framing of a house, so that it will settle evenly instead of sagging in the middle. We do that by taking care to preserve the same relationship between the horizontal and vertical members of the frame everywhere, so that when the beams and girders shrink the house will settle uniformly at the sides and center. That is a good reliable method. But I don't know any recipe to stop the shrinkage of green boards and trim. Shove them tightly together, nail them fast, yet they pull apart in time."

Mitered clapboards on the corners of a house, as shown above, look best; but other methods are just as good from a practical standpoint.

"There's some difference in the kind of lumber," was my comment.

"Not enough to count. I have a white pine table made of square edged boards that were tight together a few years ago, but now they are an eighth of an inch apart. Matched spruce on an outbuilding kept painted shows daylight between every pair of boards. Cypress and long leaf yellow pine are special old pals of mine, still I have to admit they shrink. I worked on a house not far from here and the oak flooring was a handsome job when it was new. After three years the oak strips had shrunk so much that the tongues were pulled clear out of their grooves. It took a lot of crack filler to patch that job, and then it was a poor imitation of a first-class floor."

"CAN'T you tell green lumber when you see it or saw through it?"

"Some may pretend to, but I don't," replied Uncle Ed. "A piece of wood doesn't have to drip water or be sticky in the saw cut when it is unseasoned. The moisture is in the pores. The principal safeguard is to buy your stuff from a reliable dealer. You depend on him not to hand you raw lumber fresh from the car. He has a large stock in reserve that seasons slowly in the yard, better under cover. You can also use your own eyes and turn down the bright, fresh lumber on top of the pile. Look for the dusty weather-beaten old stuff at the bottom. White pine turns yellowish with age and other wood generally darkens. That's a sign of seasoning. Some of the old material may be checked or cracked at the exposed ends, which means extra wastage in cutting; still it's better than the brand-new shrinkable stock."

"HOW about buying material ahead and letting it season at home?"

"That's a good scheme for small jobs or where you have storage room; and you can save money, too, by buying in the slack winter season. I do that myself, always keeping on hand quite a mess of lumber, from molding to boards. Every attic is half or three quarters empty and will hold a truckload of lumber. It's a fine dry place. Then you have the upper part of your garage, across the ceiling beams. It is a good idea to stack lumber with little strips to separate the pieces so that air can circulate all around them."

"The house painter is quite a scapegoat for shrinkage," I observed.

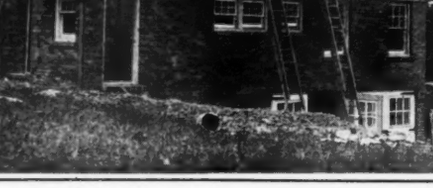
"Saving the bacon for the rest of us," laughed Uncle Ed. "I've heard an owner say, 'That scoundrel of a painter cheated me. Look at his careless work—didn't paint the joints in that matched ceiling for the porch. The bare wood shows in every joint.' Someone told him that the joint opened after the paint was put on, but he wouldn't believe that the painter had covered all the surface in sight at the beginning. Green lumber gives another black eye to the fellow with a brush when the paint he so carefully applied peels off in large patches like the skin of an onion."

"You mentioned warping as second cousin to shrinkage."

"First," corrected the old craftsman, "and sometimes I think they're blood brothers. The first antidote for warping is to use quarter sawed or edge grain stock, whether in shingles, trim, or flooring. Of course, seasoning counts, too.

"THEN it makes a difference in a new building whether the plaster is thoroughly dry when the finish woodwork is put in. A hurry-up job, with the trim slammed on when the house is still damp, invites warping trouble. That reminds me of a shrinkage point. The owner of a new house wants the doors and windows to work easily. Let me tell him it is better to have the doors and windows tight enough to need coaxing if not downright wrestling to operate. Such a snug fit is a nuisance for a couple of years, but when the lumber has shrunk, everything is just right. A new house needs to be broken in the same as a car,

Don't trust to the painters to make the tops of exposed windows rain-tight, says the veteran carpenter. Make sure they are by using metal flashing on the drip caps. A dollar's worth of copper flashing on a window will save ten dollars in repairs.

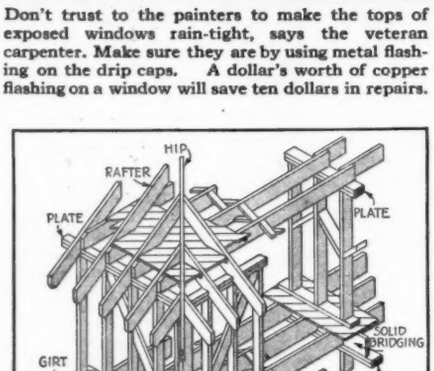


If the strips of an oak floor are not well seasoned before laying, they may shrink until wide cracks appear between them, necessitating repair.

and people should be willing to stand a little inconvenience in either case."

"Doesn't the kind of wood make a difference in warping?"

"That's right. White pine, cypress, and cedar don't twist around as much as most other kinds of wood. I have seen on the outside of a house a piece of maple molding that had torn itself loose from the nails and curved out like a snake, wriggling as if it was alive. What was maple doing outside? Of course it had no business to be there. This is something to warn the public on—how careless or crooked builders slip in any kind of lumber for trim, (*Continued on page 133*)



Courtesy National Lumber Manufacturers Association

How the frame of a well-built house is constructed. Studs and joists are spaced 16 inches apart. Rough floors and sheathing are laid diagonally for strength; exterior walls braced.

Do You Know How Your Icebox Is Built?

Improper Insulation the Cause of Poor Refrigeration, Our Tests Show

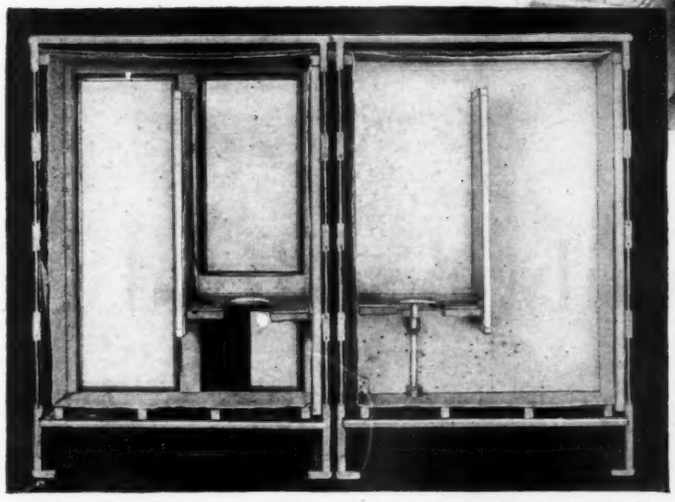
By R. D. MORRILL, M. E.

In Charge of Refrigerator Tests for Popular Science Institute of Standards

Photograph 1. Thin felt and ground cork insulation. Outside temperature 80; inside, 59.

HOW much did you pay for your icebox? That question is mighty important because it involves both your health and your pocketbook.

Although the United States uses far more iceboxes than any other nation in the world, investigations conducted by the Popular Science Institute of Standards have developed the alarming fact that most of these iceboxes are practically worthless for preserving purposes.



Photograph 2. Two layers of felt, an inch of air. Outside, 80; inside, 64.

Because they are incapable of maintaining the low temperatures required to arrest the growth of bacteria, food spoils in them almost as fast as it would on the shelves of a closet. The dangers of such spoilage have already been discussed in this magazine by a medical expert. Next to health, waste is the most important problem in domestic refrigeration. A poor icebox wastes an unbelievable amount of food and ice.

In principle, an icebox is a simple apparatus. It consists of an outer shell, or casing, and an inner shell, or lining, the space between the two shells being filled with material that is a poor conductor of heat. Then why, you may ask, if it's so easy to make an icebox, does any manufacturer turn out a poor one?

The answer is contained in one word—price. Though the principle of the icebox is simple, good iceboxes are expensive to make and manufacturers are forced to regulate the quality of their product to suit the prices the public is willing to pay.

THERE are, of course, "gyp" icebox manufacturers who charge big prices for ornamental but useless refrigerators, but the reputable manufacturers turn out the best iceboxes they can make for the prices they can get.

If you are unwilling to pay the price which a manufacturer must ask for a really efficient refrigerator, you will get an icebox built as were the three shown in the accompanying illustrations. These iceboxes cost at retail $56, $49, and $61.

TESTS at the Popular Science Institute of Standards demonstrated that not one of them was capable of maintaining a food preserving temperature during summer weather. Each of them was tested for efficiency in a room where any temperature between freezing and 120° can be maintained constantly for any length of time desired, regardless of outside weather conditions.

Photograph 3. Cork insulation an inch and a fraction thick. Outside temperature 80; inside, 56. Cork should be at least 2 inches thick.

When you buy an icebox, you pay for construction, fittings, appearance, and efficiency or good heat insulation. The three iceboxes illustrated meet these requirements in every detail except one—proper insulation.

TO MEET the prices at which the boxes were sold, something had to be skimped and the manufacturers economized on insulation, because the insulating material, being placed between the inner and outer shells, cannot be seen without tearing the icebox to pieces.

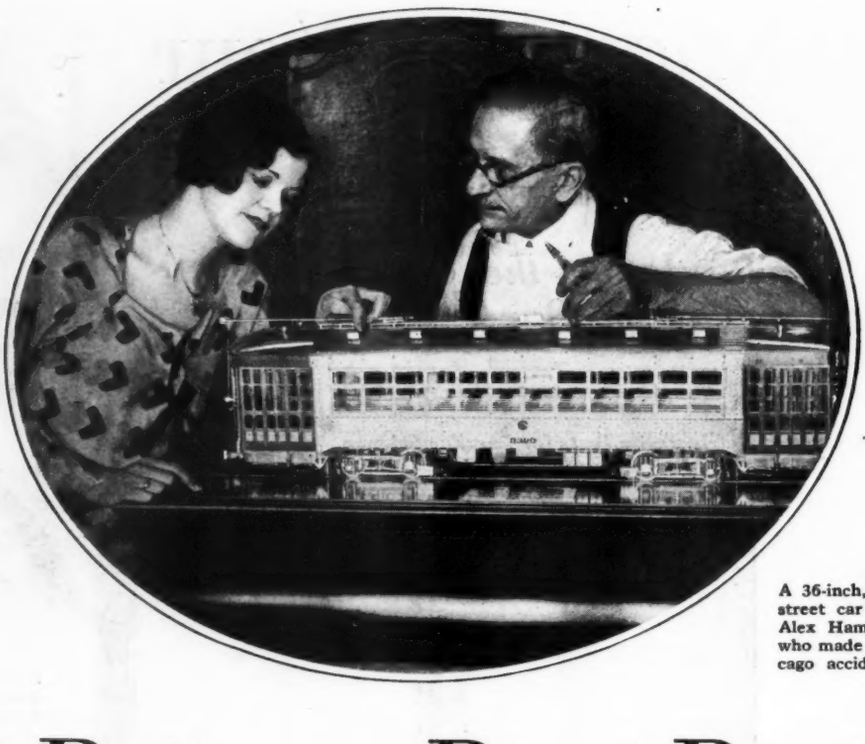
Before these boxes were taken apart, the differences in the amounts of insulating materials they contained were indicated by the Institute tests.

The best of the three boxes, the one illustrated in Photograph 3, had solid cork insulation averaging a fraction more than an inch thick. Cork is one of the best insulating materials, but an efficient icebox requires at least two inches of cork.

When the temperature was held at 80°, this icebox maintained an average temperature of slightly more than 56°, or 6° above the point where bacteria begin to multiply with alarming rapidity.

The icebox in Photograph 1 is a less efficient refrigerator. A space of about an inch between the outer and inner shells contains two thin layers of felt and the rest of the space is filled with ground cork. This, of course, spilled all over the floor when the investigator's saw cut through. With an outside temperature of 80° this box maintained an inside temperature of more than 59°. The ice-

(*Continued on page 142*)



A 36-inch, 550-ounce, sterling silver street car with track, exhibited by Alex Hammar, veteran silversmith who made it as a trophy for the Chicago accident prevention campaign.

Model Railways Rival Real Ones

Amazingly Complete Systems With Tiny Locomotives Using Their Own Power Used to Teach Transportation Methods

By L. G. POPE

TINY steam railroad locomotives that burn real coal and yet are no longer than your foot—miniature Pullman, baggage, and freight cars perfect in every detail—tracks, signal towers, switches, and other railroad equipment exactly like their full-sized prototypes are being produced by the patient skill of model makers in all parts of the world.

So realistic are some of these model railways, and so complete are they in every detail, that photographs of them can hardly be distinguished from photographs of real railroads.

This fascinating hobby, model railway building, appeals most strongly, of course, to men who have, at some time in their lives, been connected with a real railroad. But the lure of the shining rails and the steel monsters that travel on them seems to ensnare thousands of people who have never had any connection with a railroad beyond riding as a passenger.

There is, for example a middle-aged clergyman living in a quiet rectory in the south of England who has produced some marvelous examples of the model builder's art, both in railroad locomotives and in various types of stationary equipment.

And there is C. A. Lehman, an instructor in the schools of Long Beach, California, who has constructed what is said to be one of the most perfect sets of transportation models ever built. These locomotive models, capable of running under their own power, portray the development of railway transportation over a period of 100 years. They range all the way from a model of the *Tom Thumb* built in 1828 for the Baltimore and Ohio Railroad to a model of the gigantic modern Union Pacific three-cylinder passenger locomotive.

Models, large and small, of almost everything that runs on rails, made by experts and exhibited and explained at a recent English exposition held in Kingsway Hall.

Crossing the water again, we find E. P Keen, of London, Chairman of the Model Railways Club, who has spent years on the construction of a remarkably complete model railway. Practically every common type of rolling stock is duplicated in miniature on his model railway. All the varieties of "goods wagons," as freight cars are called in England, are standing on the sidings of his railway.

WHILE most model railway construction is done as a form of recreation, many models

are built commercially for exhibition. One of the most beautiful of such models was recently completed by a firm in Chicago, Illinois. It is a model of a street car, made accurately to a scale of three quarters of an inch to the foot and is perfect in every detail. It is built entirely of sterling silver.

In his constant striving for accurate small scale reproduction, the enthusiastic model maker seems to be willing to go to almost any amount of trouble. It appears to make no difference how much work is involved or how long the work will take. The main requisite is true scale modeling.

FOR track laying, for example, the really good model makers procure special brass or steel rails, rolled to a cross section just like those of real rails. These rails are spiked to wooden ties according to American standard practice or held in chairs by wooden wedges according to the English system.

Switches are constructed from the plain rails to duplicate full sized construction.

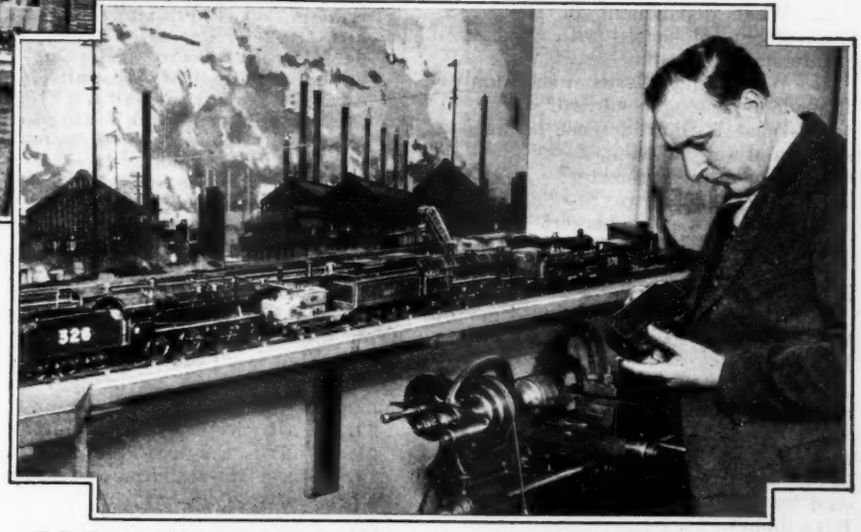
Even the boilers of the tiny steam locomotives are held together with rows of almost invisible rivets. They are, in fact, true models of their gigantic prototypes!

The power of some of these small locomotives is astonishing. Engines suitable for operating on track measuring but two and a half inches between rails are capable of hauling a load of several men riding on specially constructed flat cars.

Model railway building naturally develops skill in the use of tools and a surpassing degree of ingenuity in working out constructional problems. But the chief requirement of all is patience!

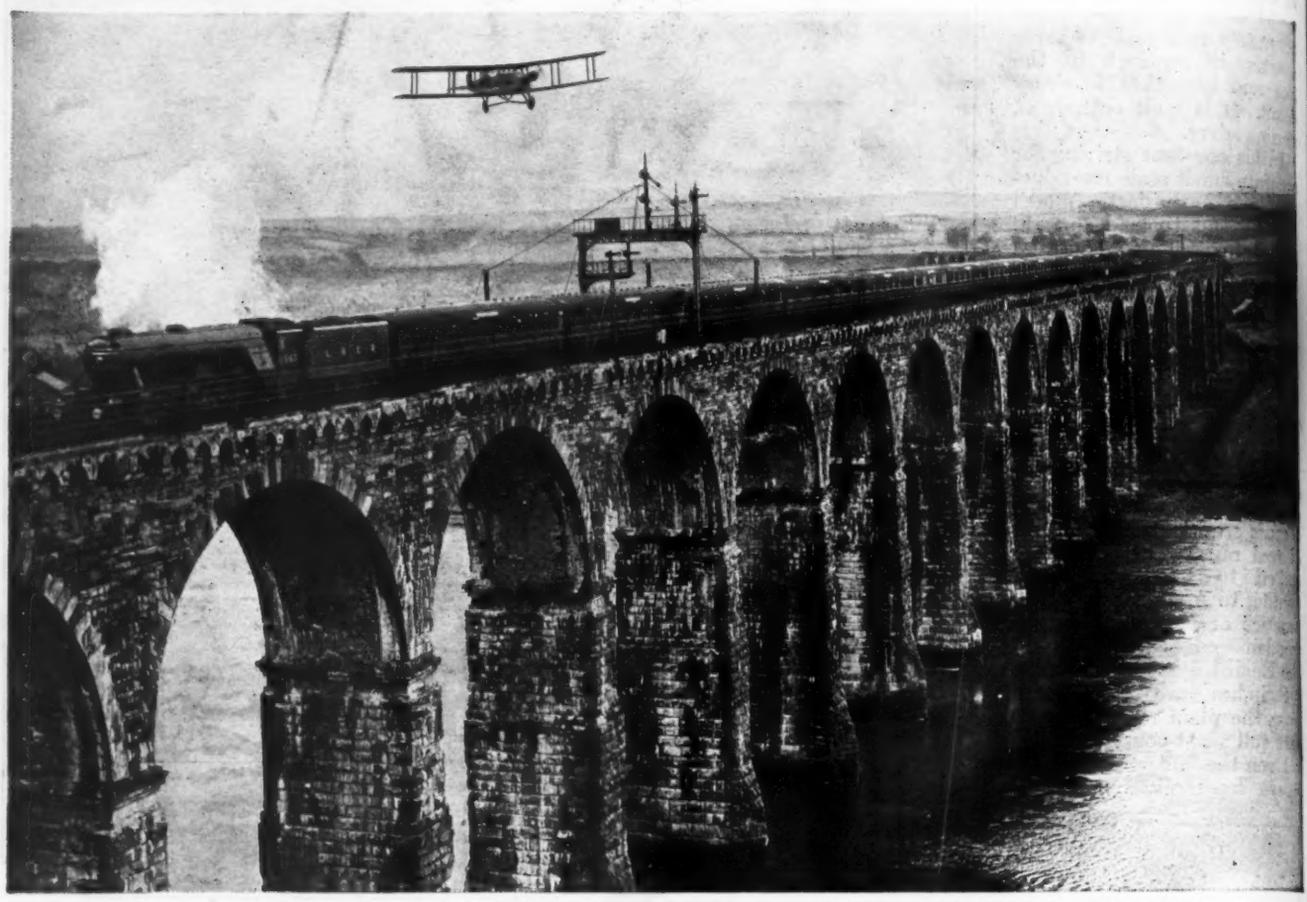
A hundred years' history of rail transportation shown in models running under their own power from the Baltimore & Ohio Railroad's *Tom Thumb* of 1828 to the Union Pacific's three-cylinder giant of 1928. All were made for the Pacific Southwest Exposition by C. A. Lehman of the Long Beach, California, public schools, pictured above with some of his students.

Left: A complete model railroad system, all made by hand and completed after years of labor by E. P. Keen, Chairman of the Model Railways Club of England and Mrs. Keen, who are seen in the photograph with a friend, looking over part of the system.



E. P. Keen repairing an engine tender of the most complete model railway in the world, a marvel of accuracy and detail. This photograph shows part of the yards and the scenic background.

Plane Races with Crack Train



The locomotive *Flying Scotsman*, which claims the world's nonstop record, was not half fast enough for the airplane *City of Glasgow* when the two recently raced 400 miles from London to Edinburgh. But it was a stirring spectacle as they passed over Berwick Bridge.

What Do You Know About Aviation?

HERE is a chance to find out how much you really know about aviation. These questions were compiled for readers of POPULAR SCIENCE MONTHLY by Professor Alexander Klemin, Director of the Guggenheim School of Aeronautics at New York University. The average person should be able to answer fifty percent of the questions. Test yourself. Then try the list on your friends. The answers are on page 132.

1. When, by whom, and where was the first flight accomplished in a heavier than air machine with power?
2. How were the early airplanes made to take off?
3. What department of the U. S. Government is charged with regulation of interstate air traffic?
4. What country leads in the number of airplane passengers carried?
5. What is the difference between a rotary and a radial engine?
6. What is a tachometer?
7. What is an airway?
8. What is a supercharger?
9. Why is an airplane engine costly?
10. What causes the so-called "bumps" in flight?
11. What is the scheduled time of the air mail from New York to San Francisco?
12. Which is the safer flying, high and fast or low and slow?
13. How can one be assured of a safe airplane "joy ride"?
14. What is the official distance covered by Lindbergh in his New York to Paris flight?
15. What is a sock?
16. Who accompanied Commander Byrd in his flight over the North Pole?
17. What are the two main types of airplane wing structure?
18. What is an ornithopter?
19. What are the advantages of a monoplane over a biplane?
20. Is a hydroplane an aircraft?
21. What is the fin and its function?
22. What is the stabilizer and its function?
23. What is an aileron and its function?
24. What is a cowling and its use?
25. What is a parasol monoplane?
26. What are longerons?
27. Of what materials are propellers made?
28. What is a strut?
29. What covering is usually used for airplane wings?
30. What section of the United States furnishes our principal supply of airplane wood?
31. Why is steel used in fuselage construction more generally than duralumin?
32. What change in design is advisable when brakes are used in the landing gear?
33. What is a streamlined wire?
34. What is a glider?
35. What is the weight of a cubic foot of air at sea level at 32 degrees F. temperature?
36. What effect does a decrease in air density have on flight?
37. Which furnishes the greater part of the lift, the upper surface or the lower surface of the wing?
38. Why is the long dimension of the wing always put across wind?
39. In what direction relative to the wind should an airplane land and take off?
40. For what are wind tunnels used?

Mrs. Richard E. Byrd, who considers herself lucky to have as her husband a man so valuable to the world. Right: Commander Byrd on the recent occasion of his receiving the honorary Doctor of Aeronautics degree at the Pennsylvania Military Academy.

Three children of Commander Byrd, adventurer, at play in the Boston Public Gardens. They are, from left to right, Catherine Byrd, Bolling Byrd, and Richard E. Byrd, Jr.

DICK BYRD—Adventurer

An Intimate Study of the Great Explorer at Home—How He Plans an Expedition—Why He Is Going to the South Pole

By FITZHUGH GREEN

"HE IS still sleeping," the maid told me when I came down to breakfast at eight o'clock. I was spending a whole twenty-four hours with Commander Richard E. Byrd at his home in Boston to see exactly what such a man does when he is not flying over some Pole or on some other exciting adventure, and the girl's words seemed to indicate that this was a lazy man.

But he isn't lazy. It is merely that in working and in living he practices sane economy. He doesn't plunge into his work nervously, making much haste and little speed. His inclination is to take things easily and do the important jobs in systematic order.

Just after nine he appeared, perfectly groomed in close-fitting blue serge, his dark eyes clear and snapping after nine hours' refreshing sleep.

HERE is the answer to a question that has been asked over and over again—What does Commander Byrd's wife think of these trips of his? And in this, fifth and last in a series by Commander Green, himself a famous explorer, are never before published facts about the South Polar expedition.

"Sorry, old top," he apologized laughingly, "for not showing up sooner."

"Why worry," said I. "My breakfast was waiting for me, if you weren't."

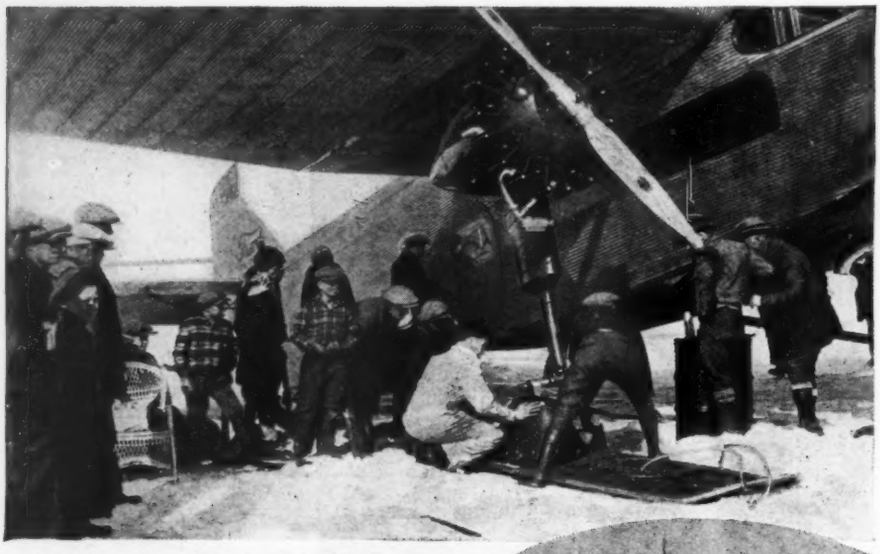
He laid his hand on my arm and spoke into my ear as if imparting an important secret—which he was.

"But it's sleep that makes the breakfast taste good, isn't it?"

A typical remark from Dick Byrd. For to him health goes before all else. I have seen him turn down money to get an extra hour of sleep; refuse a banquet to avoid breaking training; deny an interview with an important man rather than miss his daily exercise.

Yet few men can equal Byrd in sacrificing sleep when necessary. On the Greenland trip he flew across Ellesmere Land three days in succession with an average of about three hours' sleep each day. He hopped off for the North Pole with only two hours' sleep. Before he crossed the Atlantic by air in 1927 he went to bed at two A.M. and got up at four A.M. to remain awake for more than forty-two hours!

On this day at his home he did a characteristically seafaring thing before



A test at The Pas, Manitoba, of the Ford all-metal plane built for Commander Byrd's exploration of Antarctic wastes. Its wheels are being replaced with skis.

he sat down to his breakfast. He took a squint at the sky and glanced at the barometer.

"In for a bit of wind," he observed.

I glanced out on the unruffled surface of the Charles River which mirrored a cloudless sky, but Dick was right—in two hours the sky was overcast and the basin slashed by a stiff east wind.

He ate heartily—and slowly, taking time out to listen to a boyish yarn by Dick, Jr., to exchange a kindly word with the maid, to share a mouthful now and then with Igdlu, his favorite dog. He had orange juice, hot cereal, two eggs, toast, and tea.

"Don't use coffee," he replied to my question. "A man can travel farther and work harder on tea. In fact I like hot chocolate best of all."

I took this to be his attitude towards all stimulants: use them sparingly or not at all if you expect to get a lot out of the body as a machine.

Now came another small formality—the morning paper.

"I like to know what other people are doing," Dick explained. "And after all, the most interesting thing in life *is* people—don't you think?"

BREAKFAST and morning paper took about forty-five minutes. By this time his secretary had arrived and opened two mountains of mail in his small office in the front of his house. "And more out in the hall," she told me.

Dick came in with a cheery "Good morning." The secretary flashed a smile in reply, but turned almost instantly to her shorthand book. I understood why, for Byrd had a letter in his hand and was dictating a reply even before he sat down.

That is one of the misleading things about the man. Because of his soft southern drawl and bland manner you are likely to think of him as anything but a man of action, but you are wrong.

"I deeply regret that it is impossible," he snapped out. "There are at least four good reasons: . . ." With almost mathematical precision he enumerated the arguments against his doing what the writer of the letter requested.

He may handle as many as 300 letters before the day is over.

In his offices in New York, which he visits every few days, his mail is likely to be even larger, and his visitors more numerous.

After an hour with his secretary he has his first visitor. This may be almost any kind of person; today it is a scientist with a scheme for an expedition after Byrd has come back from the South Pole.

BYRD smiles. He is used to this sort of thing. Gently he disposes of the caller, always making a friend rather than an enemy. Then the next visitor; and so on for three hours.

At noon comes the daily walk followed by luncheon at one. The afternoon is even busier; but it, too, ends in exercise—golf, tennis, squash, swimming, or boxing. In the evening he lectures, writes, reads proof, or confers with his staff.

But what of his charming wife and four lovely children? What do his adventures mean to them?

"There must be something wrong with a man who would go off and leave his family!" exclaimed one lady to me when she discovered that the famous air explorer was married.

I inquired why.

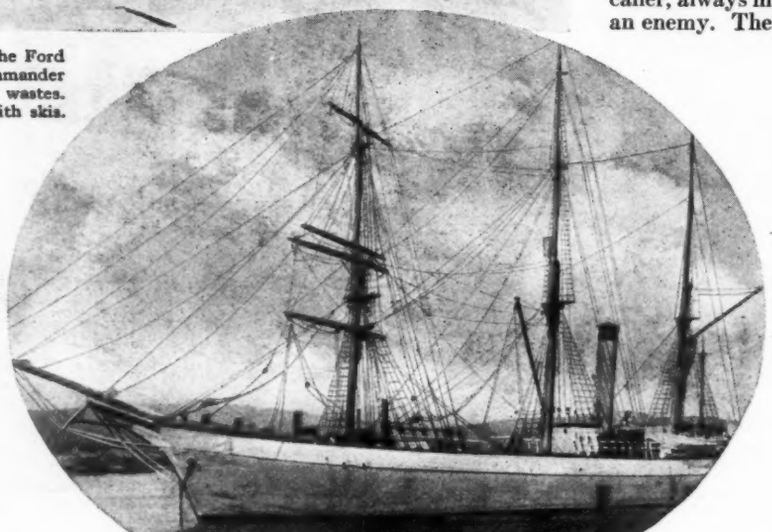
"Because he leaves them for months and months. He risks his life time after time. And what do they get out of it all?" The best answer is in Mrs. Byrd's viewpoint.

"There is no use trying to analyze a man's reasons for being an explorer," she said, when I asked her about it. "But if he enjoys his work and does it well, he is filling a niche in human endeavor that some one has to fill. I feel I'm lucky to have a man chosen by fate for so valuable a duty."

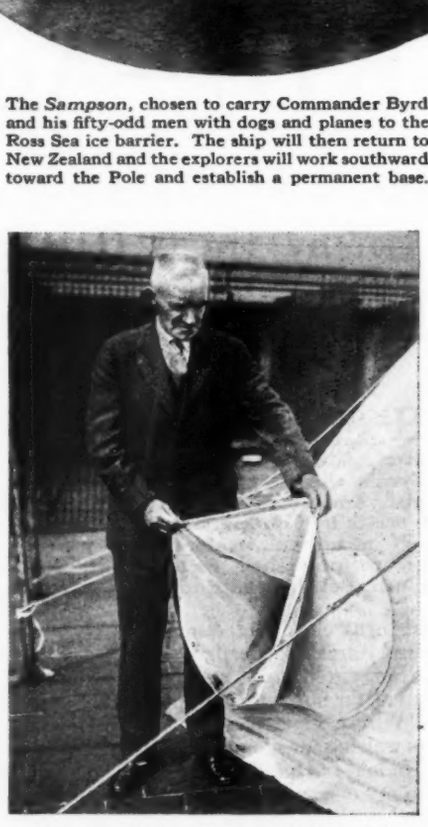
SHE vigorously lives up to that philosophy by working elbow to elbow with her husband. Yet not for a moment does she neglect her children. Indeed, she is as competent a mother as ever lived. And she is as free as Byrd from that miserable avarice which keeps most of us chasing the almighty dollar.

They live modestly. He gets about $4,000 a year Navy retired pay. He owns a small brick home. He has written one book and about a dozen magazine articles in two years.

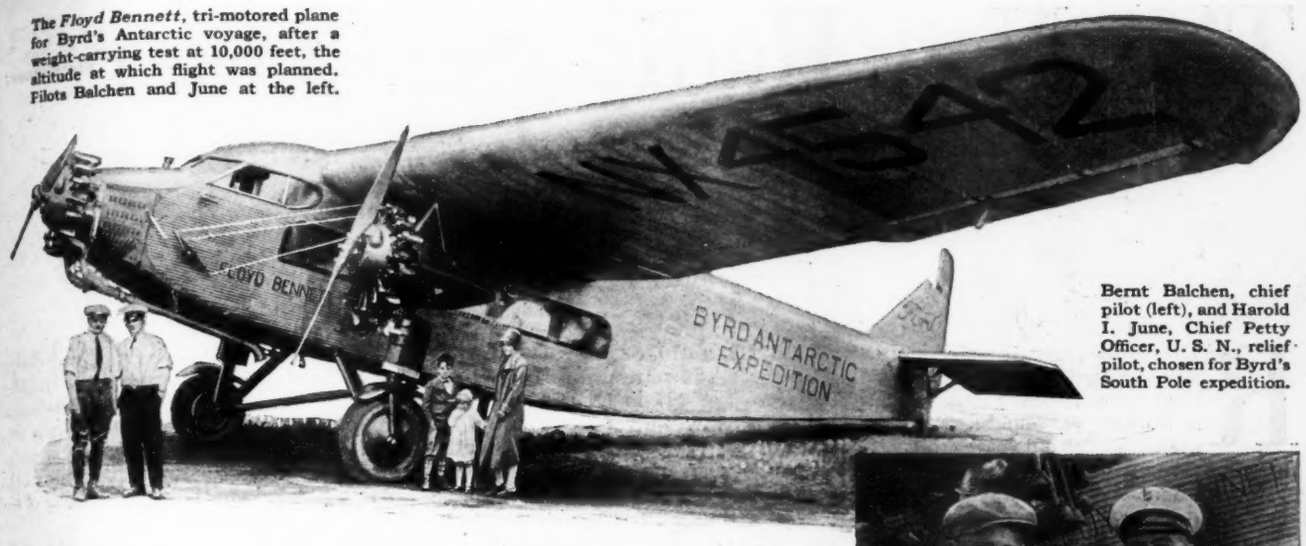
"But doesn't he make a lot out of his lectures?" I am asked. Yes. So did Peary and Amundsen and other explorers. But, like them, he feels that such



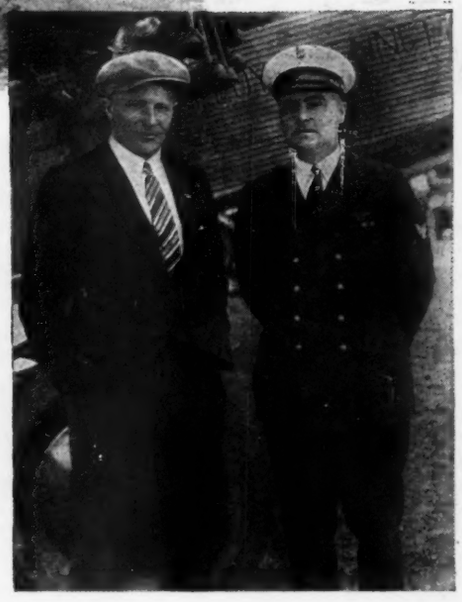
The *Sampson*, chosen to carry Commander Byrd and his fifty-odd men with dogs and planes to the Ross Sea ice barrier. The ship will then return to New Zealand and the explorers will work southward toward the Pole and establish a permanent base.



Arthur T. Welden, in charge of dogs of the South Polar expedition, shows funnel-like entrance of the tents he devised for the party.



The *Floyd Bennett*, tri-motored plane for Byrd's Antarctic voyage, after a weight-carrying test at 10,000 feet, the altitude at which flight was planned. Pilots Balchen and June at the left.



Bernt Balchen, chief pilot (left), and Harold I. June, Chief Petty Officer, U. S. N., relief pilot, chosen for Byrd's South Pole expedition.

money should go back "into the business." In other words, he is one of the biggest subscribers to his own scientific expeditions.

There are plenty of chances for Byrd to make quick money if he chose.

I was present once when $100,000 was offered him for the news rights to an historic flight, but there was no guarantee that Dick's companions' writings would be purchased.

"Sorry," said Byrd, "but I can't do it. They have families as well as I." His eyes twinkled. "Then you know, sir," he added, "their stories will probably be better than mine."

DICK BYRD'S great work at the present moment is preparation for his flight across the South Pole. Shortly after this will appear in print he will steam in the little ice ship, the *Sampson*, through the Panama Canal, and thence down to New Zealand to make his last stop before crossing the Antarctic Ocean for the South Polar regions.

In preparation of this article I asked him *why* he was going to fly over the South Pole. For reply he penciled the following paragraph:

"There lies down there at the bottom of the world a vast unknown region as big as the United States and Mexico combined, that the eyes of man have never looked upon. That great unknown area is in the clutches of an ice age—a glacial period such as existed in this country of ours ages and ages ago. And so it is that this ice-covered land is a great mystery, and offers the last great challenge to the aviator and the explorer."

He went on to remind me that Antarctica is a continent surrounded by a barrier of ice in most places 300 feet high. This is quite different from the North Polar area which is surrounded by the Polar Sea some 2,000 miles in diameter.

"We know," he went on, "that fierce gales spring up suddenly and last for days. We know that in places the average wind velocity has been over fifty miles an hour for a long period, meaning that winds must rise as high as 130 miles an hour at times."

Since the temperature goes down to seventy degrees below zero, the cruelty of such gales can be imagined.

"We are taking about fifty-five volunteers from more than 3,000 applicants for the expedition, seventy-five Eskimo dogs, and two North Greenland Eskimos.

"We shall have with us three airplanes. These we shall use to lay out a line of supplies southward from our base on the Ross Sea ice barrier. This barrier is a solid hunk of ice 400 miles wide, 500 deep, and rising from a few feet to 300 feet above the level of the sea."

He did add what is to me a most interesting point. When Scott and Amundsen went down in 1911 they based near together, the former refusing to put his camp where Byrd will put his. Scott felt that there was some danger of the ice tongue breaking adrift and carrying his entire base with it out into the Antarctic Ocean. Byrd knows this, but with characteristic courage looks on it as one of the acceptable hazards of exploration.

William C. Haines, Weather Bureau meteorologist, chosen for the Byrd expedition, with some of the instruments he planned to employ.

"THERE we will build a self-sustaining town, while our vessel goes back to New Zealand for the winter," he went on.

This means that during the black six months' Antarctic night he and his men will be cooped up in that icy desert with the howl of the blizzard overhead and the ominous crackling and booming of the ice beneath their fragile huts. It means that for six months this half a hundred men must keep house, cook, sew, scrub, nurse, and do all the other things which a bachelor must do, isolated at the ends of the earth.

When the sun comes back it will bring with it more severe cold than ever. "When the days begin to lengthen, the cold begins to strengthen," runs the old Klondike proverb. But light of the Polar dawn will enable dog sledges to go out southward even before the planes can be put into commission. And by the sledges the food depots will be checked up and dug out from the drift of winter snow.

FINALLY, the great southward flight will be attempted with the big three-motored Ford plane. First there will be a traverse of some 400 miles over a gradually ascending field of snow-covered glacial surface; then a sharp rise of about 6,000 feet between the mountains discovered by Scott, Shackleton, and Amundsen. Thence a direct flight to the South Pole which lies at the center of a vast and frigid plateau at an elevation of about 11,000 feet.

This flight will constitute the most spectacular phase of the whole enterprise. It will not amount to any new achievement, save as another proof of Byrd's boldness and the airplane's competence as an aid to exploration. But after it is finished will begin the more exciting work, even though it (*Continued on page 140*)

The New Radio Sets Offer—

Higher Values—Better Tone, Selectivity, and Volume—Lighted Dials—Dynamic Speakers

By JOHN CARR

RADIO today presents a strikingly novel situation. Tremendous improvements have been made in the last year—more, perhaps, than in any recent year—and yet these improvements have all been accomplished without the aid of any basically new invention or discovery.

Radio sets of different makes are becoming more alike in external appearance, and in many cases in the interior arrangement of the apparatus as well. And in the sets designed to be given to the public this Fall and Winter, there has been a marked abandonment of freak ideas.

Undoubtedly the most notable recent improvement has been in the development of faithful tone reproduction. Even the lowest priced of the new radio receivers offer a tone quality unobtainable from even the most expensive sets a few years ago.

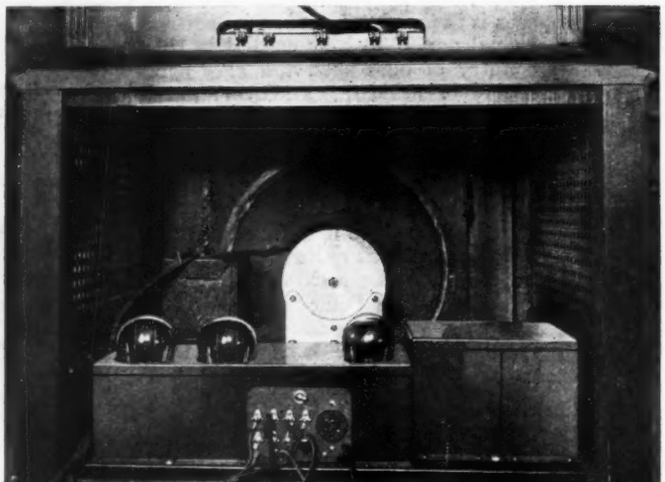
All the other new refinements tend to make the modern radio receiver simpler in operation, more attractive in appearance, easier to tune, and more selective.

About this time last year, an article in POPULAR SCIENCE MONTHLY heralded the coming of the full electric set, the radio receiver operated entirely without the aid of batteries. At that time there were three distinct systems for full electric operation. These systems consisted, essentially, of operation by means of vacuum tubes with the filaments heated by low voltage alternating current, operation with battery type tubes connected in series with an overgrown B-eliminator to supply extra current for the filament circuit, and operation with battery type tubes where the current was supplied by a combination A and B eliminator.

OF THESE three, after a year's trial, operation with the so-called A. C. tubes has proved most popular. Practically every new model is of this type and the development of good A-B eliminators has made possible the conversion of many old battery sets to full electric operation.

Most of the newly designed sets use A. C. tubes of the 226 type for the radio-frequency stages and the first audio stage, a type 227 tube for the detector, and a 171A, a 210, or even a 250 for the last stage. A few are using heater tubes similar to the 227 in all stages. Power tubes are now universal, nothing less powerful than the 171A being supplied.

In radio frequency, detailed refinements have noticeably improved the average receiver's ability to bring in distant stations and to choose between them. Single dial control now is a matter of course.



An inside view of the most powerful combination dynamic loudspeaker and power amplifier now available, complete in a console table. At the left are the two UX 250 power tubes that are used in a push-pull circuit.

Like the gear shift on the automobile, which after years has finally become standardized, the control of a radio set has nearly reached that state. The standard now is one knob to control tuning, another to control volume, and a simple snap switch to turn the set on and off. Some highly refined sets have additional controls for use only in searching for distant stations when an exceptional degree of selectivity is needed.

Careful shielding is an integral part of all new receivers. Losses due to shielding have been largely overcome by a more careful attention to the design of the coils and a greater appreciation of the need for adequate and accurate spacing.

Left: Dynamic speaker unit for use on battery current. Right: The same unit with a built-in rectifier to allow actuation direct from the light circuit.

Attention to the details of coil design and shielding has minimized the troubles caused by magnetic and electrostatic coupling. This means that the new sets are easily balanced, and a squealing, howling set that disturbs everyone in the neighborhood now is almost a thing of the past.

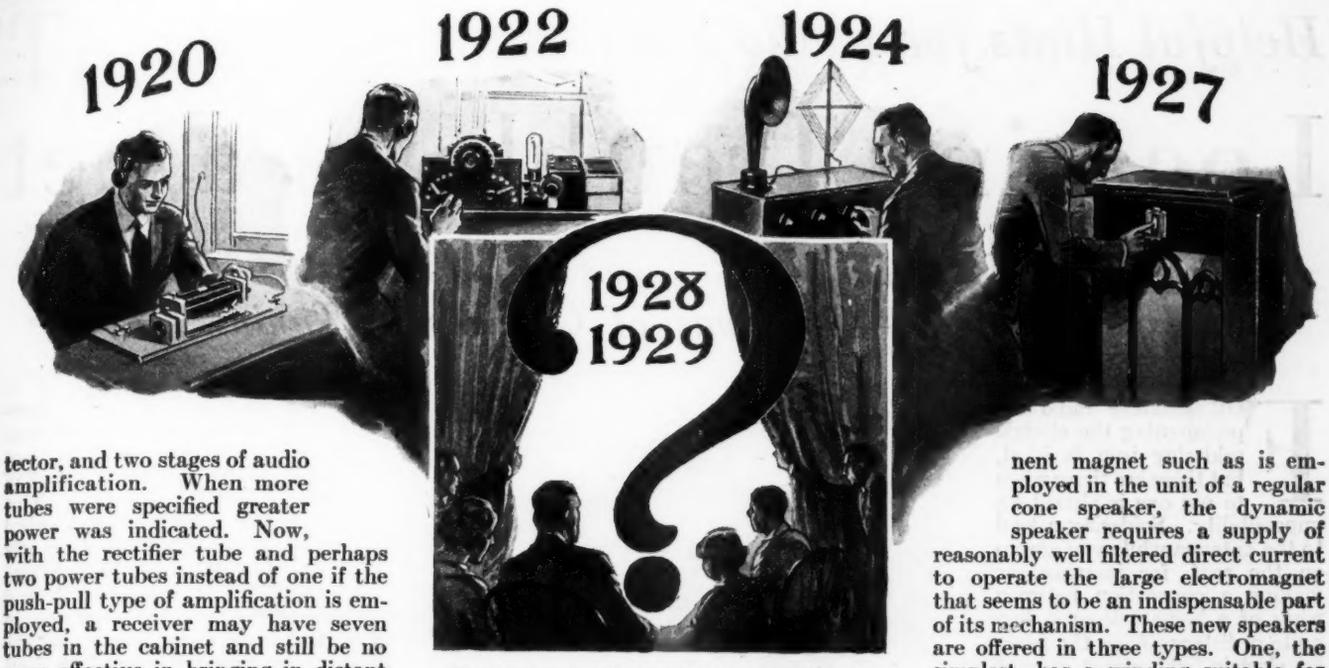
The tendency to consider the radio receiver as a piece of household furniture as well as a piece of electrical equipment has had a strong influence on the design of the cabinets in which the new models are housed.

THE chassis system of receiver construction is now almost universal. Many concerns are producing a single type of chassis which is sold mounted either in an inexpensive metal cabinet or in more pretentious wooden cabinets or console tables with built-in loudspeakers.

Marvelous improvements have been made in the finishing of the metal cabinet surfaces to imitate wood, leather, or almost any other material. These finishes will resist rust in damp climates where warping eventually will ruin any but the most expensively constructed wooden cabinet. And of course the underlying reason for the widespread use of metal cabinets is one of cost. All the new models are compact, but this compactness has been gained by careful engineering design rather than by crowding parts together without regard for efficiency.

VIRTUALLY all the lower priced new models are self contained. The single small cabinet houses both the receiver proper and the power unit, which consists of a conventional B-eliminator circuit plus extra windings on the power transformer to take care of the filament current requirements of the alternating current tubes.

This all-in-one type of construction has given rise to some confusion in the classification of radio receivers. In the days of the battery operated set the number of tubes denoted the number of stages in the set and was, therefore, a rough measure of its capability. For instance, a five-tube set consisted of two tuned stages of radio-frequency amplification, a de-



The new art of radio broadcast reception has advanced so astonishingly that receivers approach perfection and further improvement will be difficult.

tector, and two stages of audio amplification. When more tubes were specified greater power was indicated. Now, with the rectifier tube and perhaps two power tubes instead of one if the push-pull type of amplification is employed, a receiver may have seven tubes in the cabinet and still be no more effective in bringing in distant stations than a good five-tube battery set. It is well, therefore, to investigate this point before you buy a new set. Disregard the total number of tubes in the set and find out how many tuned stages of radio-frequency amplification there are, figuring one variable condenser for each stage.

The new sets seem to go to the ultimate limit in volume for home use. Any person not stone deaf can get from them enough volume, without loss of tone quality, to satisfy any possible requirement, even including broadcasting to a large hall filled with people. With the most powerful outfit produced this year you can get considerably more volume from the reproduction of a brass band than you could get if the band itself were present.

AND the tone quality even with this enormous volume is startlingly realistic and lifelike. The deepest notes of the organ boom forth like rolling thunder and the high-pitched shrill of a piccolo is equally well reproduced.

Of course, the modern sets designed for tremendous volume are in the high priced class. But complete range of volume with good tone quality is available in most of the new models. The least expensive types use a single 171 type tube in the last stage. Next come the outfits fitted with two 171 tubes in a push-pull circuit. Others use one 210 tube or one 250 tube, while greatest volume can be obtained from a deluxe receiver utilizing two 250 tubes in a push-pull circuit! A view of the lower compartment of this receiver is shown in one of the accompanying photographs. It is at this writing the most powerful broadcast receiver available.

The loudspeaker is intimately connected with the problem of good tone quality. Even the best set is useless without a good speaker. Last year the cone type speaker was at the high water mark of its popularity and there are several reasons why it probably will retain its popularity for a long time, in spite of the fact that the new dynamic speaker threatens to do to the cone what the cone speaker did to the old-fashioned horn—push it into oblivion.

UNFORTUNATELY, space limits forbid my going here into the theory and constructional details of dynamic speakers and explaining how they differ from the conventional cone type speaker, but we hope to do this in an article to appear in an early number of POPULAR SCIENCE MONTHLY.

There is no question, however, that under certain conditions the new dynamic speaker will outperform the best cone speaker. The requirements are, briefly, that the radio receiver be particularly good, and that it be fitted with a power amplifier.

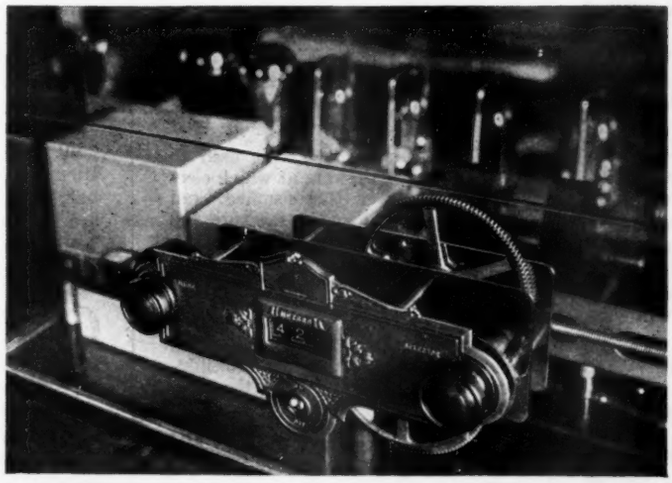
The dynamic speaker is a power operated device. Instead of using a permanent magnet such as is employed in the unit of a regular cone speaker, the dynamic speaker requires a supply of reasonably well filtered direct current to operate the large electromagnet that seems to be an indispensable part of its mechanism. These new speakers are offered in three types. One, the simplest, has a winding suitable for use on six-volt storage battery current. Another form is designed to utilize the return B-current of the eliminator. This type will produce a hum unless a really efficient B-eliminator is employed. The third type is fitted with a built-in rectifier unit.

Never before in radio have so many really excellent receivers been offered at such low prices. All the way from the least expensive to the most expensive models, you can, this year, get exceptional value for your money.

In buying an electric radio receiver, note that the general practice now is to quote a price which includes the receiver complete except for tubes. The price of the loudspeaker also is included where this part of the receiving equipment is built into the cabinet. Battery operated radio receivers were priced less accessories, which meant that you had to buy a loudspeaker, tubes, A-battery, A-battery charger, and B-batteries or a B-eliminator.

However, keen competition and low prices makes more important than ever the test work being done for your protection by the Popular Science Institute of Standards. The radio laboratory of the Institute is busy testing the various new models of radio receivers and loudspeakers being brought out at this season. While inferior design, poor workmanship, and low grade materials may get past a casual inspection, these deficiencies are sure to be revealed under the searching laboratory examination.

THE Popular Science Institute of Standards is conducted to guide you in your selection of radio and similar equipment. So before you buy be sure to find out if the equipment you expect to purchase has been tested and approved. Address your letters: Popular Science Institute of Standards, 250 Fourth Avenue, New York City.



One of the season's novelties—a direct-reading tuning mechanism. A system of gears turn numbers past the little window when knob is turned.

Helpful Hints for Radio Fans

Locating Trouble in a Set

Solder That Needs No Iron—Noises Tell What's Wrong—Long Loudspeaker Cords—Problems of Changes in Tuning Solved

FOR amateur radio experimenting the electric soldering iron is ideal, but there are times when to use one is almost an impossibility. Soldering a lead to the antenna while you are up on the roof, for instance, or making a connection between wires of a home telegraph line quite a distance from the nearest electric light socket, cannot conveniently be done with an electric iron.

Of course, a gasoline blowtorch is excellent for such emergency jobs, but you may not have one. In that case try the method illustrated on this page.

Soldering wires without an iron. The joint is covered with a paste containing pulverized solder. Then a match flame easily melts it.

Instead of the usual rosin core solder that is ideal for use with a soldering iron, you can smear the joint between the wires with a special paste which resembles automobile valve-grinding compound and is composed of finely ground solder mixed with a soldering flux.

When you heat the paste-covered joint with the flame from a match, the particles of solder melt, fuse together, and flow over the joint just as does regular solder applied with an iron in the usual way.

Of course the match flame will not supply sufficient heat to solder very heavy wire or sheet metal, but by using a gasoline blowtorch this soldering paste can be used on any job.

Long Loudspeaker Cords

WHILE there are many connections in a radio receiving circuit that should be kept as short as possible, there are practically no limits on the length of a loudspeaker cord. This means that you can run an extension cord to any part of the house with no appreciable falling off in volume. The reason is that the resistance in this part of the receiver circuit always amounts to several thousand ohms. The longest cord you could conceivably use would add only a few ohms to the total resistance. It is as though you were pumping a certain amount of water through a pipe many miles long. Adding or subtracting a few feet would not materially affect the flow of water.

Don't Be Fooled on Noises

A DOCTOR with a listening instrument called a stethoscope can tell you what is the matter with your heart. Similarly, you should learn how to tell what is wrong with your radio equipment by listening to the sounds from the loudspeaker. The doctor sometimes makes an erroneous diagnosis. The sound indications don't always work out as they should. The same thing can happen in radio.

A radio enthusiast complained the other day that there was a steady grinding noise in his receiver that disappeared when the antenna wire was disconnected. This would indicate interference from some form of electrical machinery operating in the immediate neighborhood. Upon investigation it was found, however, that there was no such interference. The noise was caused by a corroded connection where the lead wire from the antenna was clamped to the binding post of the lightning arrester. This connection had not been touched for more than a year. In nearly all cases of this type the noise produced is intermittent and scratchy, but the corrosion in this instance was such that the noise sounded just like that produced by, for example, the brushes on the commutator of a fan motor.

In any radio testing for trouble, the first thought should be to find what portion of the equipment has become defective. In this case the cessation of all noise when the antenna was disconnected proved at once that nothing was wrong with the set itself.

When the Tuning Changes

IN MOST cases where the tuning of any given station suddenly changes you will find that the station actually has shifted its wave length, and you can be positive that this is the case if other stations come in at the points on the tuning control where you normally find them. The same reasoning applies to sudden weakness on the part of a particular station. If it suddenly drops to a low volume level, do not at once start tinkering with the set to find out what's wrong. First see if other stations come in with the accustomed volume. If so, then you may be sure that something is wrong in the broadcasting station.

Of course, if all the stations seem suddenly to have shifted their wave lengths, then the chances are that something has gone wrong with your set. Most likely the dial or drum of the tuning control has worked loose on the shaft and shifted slightly. You can check this condition by lifting the top of the cabinet, turning the control to the highest number, and noting if the condenser plates are fully engaged.

Old Power Tubes Distort

CONTRARY to the usual belief, the first sign of an exhausted power tube is not weak signals. Decreasing filament emission caused by many hours of use shows first in distortion when the volume control is turned too far. On weak signals, however, an old and practically exhausted power tube may give just as audible signals as a brand-new tube.

A B C's of Radio

THE watt is the unit used to measure the rate at which electric power is consumed, and the watt-hour to measure the power used within a definite time.

A current of one ampere at a pressure of one volt is one watt, and if the current flows for one hour one watt-hour of power has been consumed. In any circuit, you can determine the power flowing in watts by multiplying the rate in amperes by the pressure in volts. Your electric meter reads in kilowatt hours, one kilowatt hour being one thousand watt-hours.

The *Real* Facts *About* Television

Institute of Standards Tests Reveal Its Shortcomings and Show How to Experiment in Newest Method of Communication

By ALFRED P. LANE

TELEVISION! A dozen times a day I'm asked to tell just when we will have television. And by television my friends mean a system whereby they can turn a knob as they do on their radio sets and see swiftly moving events, football games, yacht races, and so on recorded on a screen hung on the wall.

When I reply that I don't know, people seem astonished. For a couple of years, now, newspapers and public speakers have talked of television as an accomplished fact. It is really hard to convince the half-informed person that television, regardless of what tomorrow may bring, today is nothing more nor less than a laboratory plaything, a fertile field for experimentation. A field, by the way, that bids fair to produce a whole new crop of Edisons, for immortal fame and presumably a vast fortune awaits the fortunate individual who can take television as it is and make it what it ought to be.

Fig. 1. Experimental television receiver set in the Popular Science Institute of Standards. Left: Fig. 2. The television disk with the pitch of the spiral and the distance between the holes indicated.

SOMEDAY, perhaps in the not so distant future, we may have a television receiver that will do for your eyes what the broadcast receiver now does so well for your ears.

The principal difficulty is that television, which means the transmission of human sight, requires two-dimensional projection. Sound transmission is one dimensional. You can fuse the sound from all the instruments in an orchestra into a single complicated vibration so that it can be impressed on the carrier wave of a broadcasting station. Sight, on the other hand, is produced by the light vibrations reflected from countless numbers of points on the object seen. You could very easily convert the total amount of light reflected from the object into an electrical impulse, but there would be no way to reverse the operation and convert the electrical impulse into all the different light vibrations. It would be just the same as putting countless drops of different colored water into a common tank and then trying to separate them again.

A real solution of two-dimensional radio projection would permit us to transmit a complete picture all at once. The next logical step would be three-dimensional projection, and if that problem ever is solved we should be able to transmit solid objects from place to place instantly!

So far, one-dimensional transmission is the limit of our knowledge. It solves, of course, the problem of sound transmission, and by an optical trick we have been able to make it serve for television in the experimental forms we know today.

This optical trick is based on a peculiarity of the human eye. The optical nerves in the eye do not respond instantaneously to changes in light. You apparently see any object for at least a thirtieth of a second after the light actually is turned off. This lagging nervous action makes possible one of our most popular forms of entertainment, the motion picture. Everyone knows that a motion picture is produced by throwing on the screen a continuous string of still pictures showing successive stages of the action so that the eye is fooled into seeing what appears to be actual motion.

Television is merely the same idea enormously complicated by the fact that in addition to projecting a series of pictures, the television apparatus, because of the one-dimensional transmission, must actually split up each picture into thousands of parts and transmit the parts one after the other, all within the time it takes for an ordinary moving picture projector to project one picture.

THAT this can be accomplished at all is truly one of the greatest scientific marvels of the age, and the fact that relatively simple apparatus is used makes the feat still more remarkable.

Both the television transmitter and the receiver operate on the same general principle. Of course, the transmitting equipment is relatively much more elaborate.

At present, experimental television programs are being sent out by station WGY in Schenectady, N. Y., and probably by the time this gets into print other broadcasting stations will have taken up the work.

Television is, in its present stage of development, of no particular interest to the man who is concerned only in fully perfected results from a commercially built television receiver. It does, however, present a wonderfully fascinating new field for the radio experimenter.

Assuming that you already own a high grade radio receiver, all the additional apparatus you need is shown in Fig. 4. This picture diagram has been reduced to the simplest possible form by the engineers of the Popular Science Institute of Standards radio laboratory.

This circuit is for use with a radio receiver that employs a

TELEVISION is probably the most widely discussed of the new methods of communication.

Here is an article that explains just how far its development has advanced and tells of the difficulties that impede further progress. Readers interested in radio construction will find it of especial interest, for it details the apparatus needed to receive the television programs now being transmitted.

"Fame and fortune await the man who can take television as it is and make it what it ought to be!" says the author.

power tube such as the 171A or 210 in the last stage, and consequently is fitted with an output transformer or the equivalent in the form of a choke coil and bypass condenser.

With such an outfit, there is no direct current flowing in the loudspeaker windings. All that goes through the loudspeaker is the pulsating current that produces the signals.

In such a circuit, you must have an independent source of high voltage direct current to operate the neon tube that supplies the light for the television picture. Several forty-five-volt blocks of B-batteries or a very high grade B-eliminator can be used. A poor one will not do, because the hum it produces would be translated by the neon tube into a continuous flickering fatal to good results.

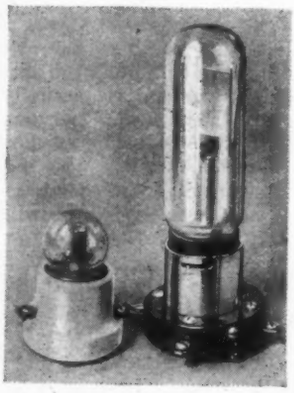


Fig. 3. Left: Small neon tube that can be used for television. Right: Large neon tube specially designed for television.

THE required voltage depends on the neon tube you use. Fig. 3 shows two possible types. With the one at left, a little tube that sells for a dollar or less, you can obtain a television picture only about five-eighths of an inch square. If you can possibly afford it, you will do well to buy a large neon tube specially designed for television. One is shown at the right in Fig. 3. The plates in this tube are large and flat so as to give the biggest possible image.

The other vital piece of equipment is a metal disk with holes drilled in it in a spiral formation as shown in Fig. 2. The diameter of the disk, the pitch of the spiral, the diameter of the small holes and their spacing depends on the equipment used in the broadcasting station and the size of the plates in the neon tube used in the radio receiver.

Of course, you need a motor to rotate the disk. It should be of the direct current type so that you can control the speed with a rheostat.

A universal type sewing machine motor with foot control probably could be successfully used, although this particular type of motor has not been tested for this purpose in the Popular Science Institute laboratory. It would depend on whether the rheostat was capable of exceedingly fine adjustment.

The only additional apparatus you need is a 1,000-ohm fixed resistance to be connected in one of the wires leading to the neon tube and a piece of ground glass. Of course, it will be necessary to make brackets to hold the motor, tube, and ground glass in approximately the positions shown in the diagram. A set-up of this type as used in the Popular Science Institute of Standards laboratory is shown in Fig. 1.

THE double pole double throw switch is included in the circuit so that you can instantly shift your radio receiver from the loudspeaker to the television equipment. This is needed because the experimental television programs are sent out only for short intervals and it is necessary to listen on the loudspeaker for the preliminary vocal announcements that precede each television program.

Assuming that you have a disk with spirally arranged holes suitable for the television broadcasting you want to receive, the first adjustment is to change the voltage applied to the neon tube until it is just on the verge of producing a pink glow. It is necessary, of course, to set the polarity of the battery so that the plate next to the disk is the one that glows. With the little tube shown in Fig. 3 this will be somewhere in the neighborhood of 120 volts; with the large tube, somewhere between 200 and 225 volts.

The next adjustment is to get the motor rotating at approximately the correct speed. At this writing WGY is transmitting at the rate of twenty-one pictures a second, which means that the disk must make twenty-one revolutions a second or 1,260 revolutions a minute. WGY is transmitting with scanning equipment that divides the image into twenty-four horizontal sections. That means that you need twenty-four holes in the spiral. The spacing between the holes and the pitch of the spiral must be determined by the size of the plates in the neon tube. If they are one inch square, for instance, the holes are spaced an inch apart and the pitch of the spiral also is one inch. The diameter of each hole should theoretically be one twenty-fourth of an inch, but it is better to make them a trifle larger so that each hole, as it passes across the picture space, will sweep a path slightly overlapping the path of the previous hole. Great accuracy is required in the laying out and drilling of the holes. Each must be precisely where it ought to be within a very small limit of error, and each must be clean and free from burrs.

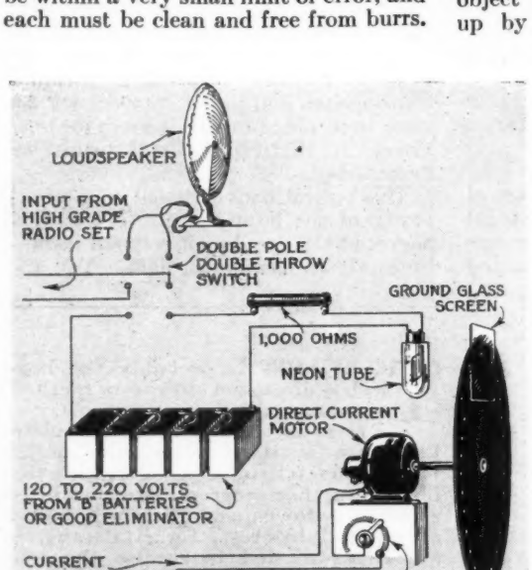

LOUDSPEAKER
INPUT FROM HIGH GRADE RADIO SET
DOUBLE POLE DOUBLE THROW SWITCH
GROUND GLASS SCREEN
1,000 OHMS
NEON TUBE
DIRECT CURRENT MOTOR
120 TO 220 VOLTS FROM "B" BATTERIES OR GOOD ELIMINATOR
CURRENT SUPPLY FOR MOTOR
RHEOSTAT TO CONTROL MOTOR SPEED
DISK WITH HOLES ARRANGED IN SPIRAL

Fig. 4. Here is a picture diagram of an experimental television receiving circuit. The neon tube should be placed closer to the disk than it appears in the drawing.

If the disk is perfectly drilled, you should be able to increase the voltage on the neon tube till it glows steadily and then, with the disk rotating, to observe a smooth, even band of light across the ground glass. If streaks appear, one or more of the holes is out of position.

Neither the number of holes in the spiral nor the number of pictures a second has been standardized. WGY is, as already mentioned, transmitting at the time this is written at the rate of twenty-one pictures a second with twenty-four holes in the spiral. Another station, which has announced television broadcasting for the near future, plans to transmit eleven pictures a second with a thirty-six-hole disk. Doubtless other stations will experiment with different combinations. You will note that each complete revolution of the disk allows each hole to sweep successive lines of light across the picture space on the ground glass until the whole area between the outer and inner ends of the spiral has been covered.

THESE disks with holes already drilled and also the neon tubes can be obtained from dealers in radio supplies.

The development which has made this form of television a possibility is the neon tube. This tube, unlike an ordinary electric light bulb, responds instantaneously to changes in current intensity. There is absolutely no lag in the action, so the amount of light given off by the bulb is always exactly proportional to the strength of the electric current flowing through it.

In the transmitting station, the neon tube is replaced by a photo-electric cell that also has an instantaneous response. The cell and the neon tube perform diametrically opposite functions. The tube produces light in proportion to the strength of current flowing through it, whereas the cell produces electric current changes in proportion to the amount of light that strikes it.

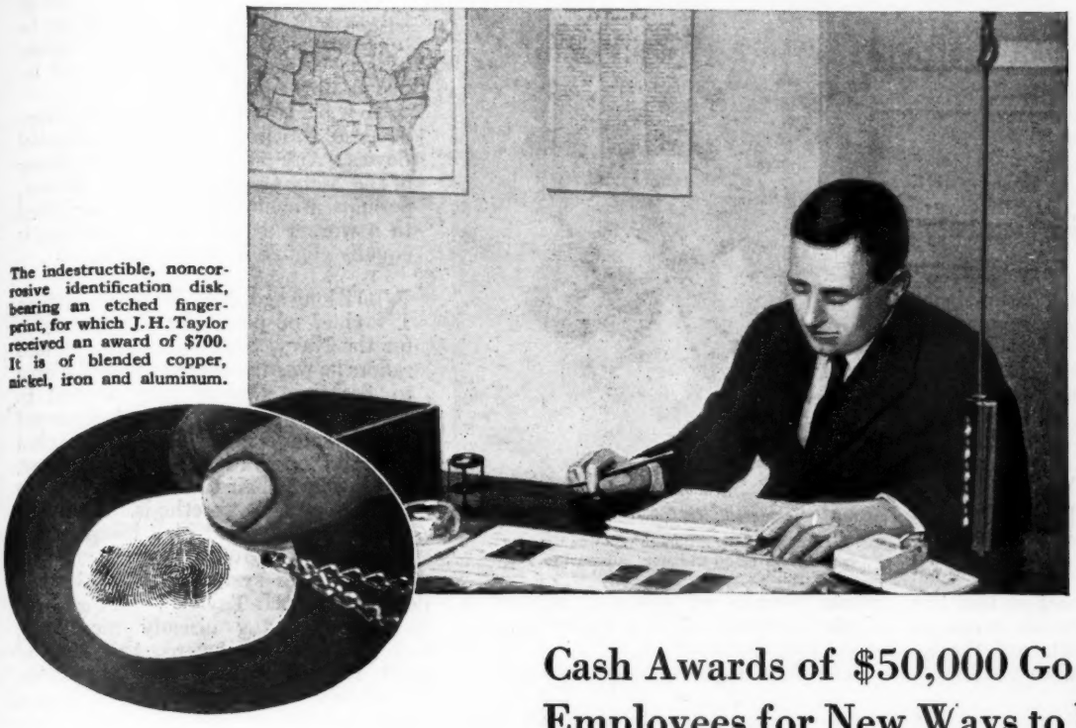
In the studio the light from the object to be transmitted is divided up by a scanning system equivalent to your disk. When the motor speed has been adjusted so that your disk is operating in exact synchronism with the scanning apparatus in the television studio, the photo-electric cell is receiving light impulses from exactly the same point on the subject being broadcast as is being illuminated by the light from your neon tube. Thus the light reflected from the subject is reproduced on your ground glass screen in shades of pink light.

The sharpness or definition is not very good. In fact you can't recognize a person's face unless it occupies nearly the whole picture space—and you are very familiar with the face.

The definition is actually worse than the coarsest screened newspaper illustration.

No satisfactory results are possible unless the signal is being received with considerable intensity, as from a local broadcasting station.

Welcoming Inventors *in the* Navy



The indestructible, noncorrosive identification disk, bearing an etched fingerprint, for which J. H. Taylor received an award of $700. It is of blended copper, nickel, iron and aluminum.

J. H. Taylor, civilian identification chief, inventor of three identification methods and of a new method to slash the cost of records.

By
NORMAN C. McLOUD

Cash Awards of $50,000 Go to Ingenious Employees for New Ways to Increase Efficiency and Devices That Reduce Costs

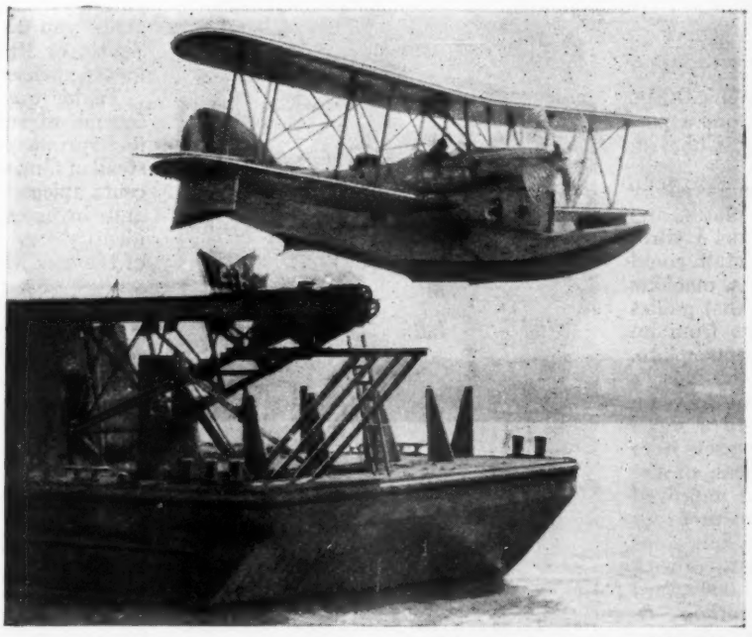
BOOM! A wisp of blue smoke rises from the distant barge that lies at anchor in the river. An amphibian plane, poised on a rail above its deck, scoots forward, reaches the end, and skims into the air.

Here is the powder type of catapult that the U. S. Navy has just announced it will place on every ship that carries an airplane. And the man who first visioned it was no Navy officer, but a civilian employee.

In his spare moments Carl F. Jeanson, in the Navy's ordnance department, dreamed of a huge gun that could shoot a plane from a ship at sea. Gradually his ideas took definite shape. One night he sketched the plans. Next day he showed them to his superior. In a few hours he was explaining his invention to high Navy officials and engineers. And shortly the Navy paid him a handsome cash award and adopted his ingenious cannon catapult.

In every bureau of the Navy Department where civilians are employed—from the scientific laboratory to the Navy yards—there has been instituted a system of bonus awards up to $1,000 to encourage inventions and the employees are allowed to retain all commercial and non-Governmental rights to their devices. They may obtain patents through the Judge Advocate General's office, saving the expense of lawyers.

Radio, navigation, aviation—these are but a few of the diverse fields in which Navy employees have demonstrated their inventive talent. From designing new metal filing cabinets to thinking up schemes for checking deserters and feeding hungry "gobs," they have contributed many hundreds of machines and ideas that are saving the Navy Department thousands of dollars, and helping to make it the best equipped in the world.



Plane being launched by cannon catapult invented by C. F. Jeanson, civilian in the Navy Ordnance Department. All plane carrying ships will have the device.

USING a submarine's hull as a radio loop antenna was the novel plan that occurred to John A. Willoughby and Percival D. Lowell in the Naval Research Laboratory at Bellevue, D. C. They devised a radio set that made the undersea craft's shell a part of the "aerial." They received one of the highest awards and their device has been adopted for submarines by the navies of every country.

For an indestructible identification tag, used by the Navy during the European war, J. H. Taylor, civilian chief of the identification section in the Bureau of Navigation, received a $700 award. He blended copper, nickel, iron, and aluminum into a noncorrosive disk carried on a noncorrosive wire around the neck. On it are indelibly etched the wearer's name and other data and the print of his right index finger. The bodies of drowned men

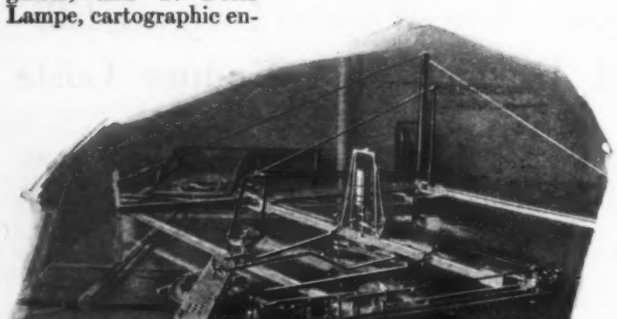
may be instantly identified, after many months, by the new tag, almost impervious to the elements.

The sonic depth finder—the precision instrument that surveys the bottom of the sea by timing sound echoes from it—was perfected by Dr. Harvey C. Hayes, a civilian in the Navy's research laboratory. His dream, of the ocean floor seen as clearly as if all the water were drained away, has come true! Two destroyers, cruising at twelve knots an hour, surveyed in a month a 34,000-square-mile area of the California coast that would have taken years to cover with the old method of weight and line sounding.

The Army submarine cable between the United States and Alaska had plagued and puzzled engineers for years with its frequent breaks off the rocky coast of Vancouver and northward. The Army cable ship, equipped with Dr. Hayes' depth finder, steamed over the route, and the cause of the breaks was discovered. Blindly, the cable had been laid over a veritable submarine mountain chain of sharp peaks. Now it was eased to a new, smooth path and the trouble ceased.

Lieutenant J. B. Williams explains the new salvage valve on the new submarine *V-4*.

A MAP-DRAWING machine that has enabled the Navy to treble its annual output of navigation charts was the invention of John H. Larrabee, senior engineer, and T. Peter Lampe, cartographic engineer, in the Navy's Hydrographic Office. Recently their device turned out a perfect chart of Port Matanzas, Cuba, in just fourteen days.

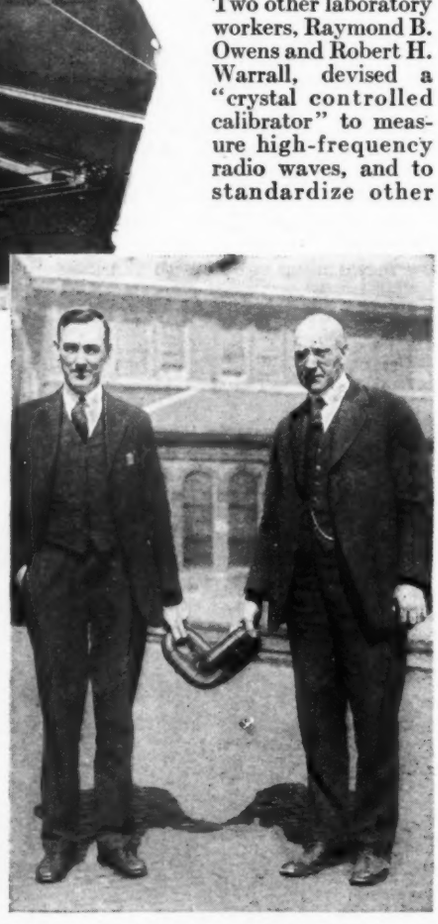


The pantograver, more accurate than its operator, which triples the Hydrographic Office map output.

Formerly all maps were engraved by hand on the copper printing plates, and twenty a year was the best the Hydrographic Office's overworked staff could do. Now the pantograver, a machine more infallible than the hand that guides it, transfers lines and figures from an original sketch on glass to the copper plate.

Radio, a favorite field for the Navy's inventors, has inspired everything from a new type of radio compass to a novel scheme of using many receiving sets from one aerial. Warren B. Burgess, of the research laboratory, made an improved radio compass that is in use in every United States installation, enabling ships along the coast to obtain bearings with unprecedented accuracy. A $1,000 award went to two of his fellow workers, A. Hoyt Taylor and L. C. Young. All Navy combat vessels carry their tube to hook a whole roomful of receiving sets to a single antenna without their "howls" disturbing one another.

The first high-frequency transmitter used by the Army and Navy won Raymond B. Meyer, of the research laboratory, a $250 award. Two other laboratory workers, Raymond B. Owens and Robert H. Warrall, devised a "crystal controlled calibrator" to measure high-frequency radio waves, and to standardize other meters, with an accuracy of one part in 50,000—a precision that far exceeded that of the best laboratories at the time. And any radio fan would be happy to own the marvelous sharp-tuning set that brought an award to Edwin L. Powell. His receiver can be tuned so closely that powerful stations of almost identical wave do not interfere in the least.



Albert Leahy (left) and James Reed of the Charlestown Navy Yard with links of their demountable chain, for which the Navy awarded them $500.

To win a Navy award, it is not always necessary to invent a new mechanical device. Any plan to make some corner of the Navy Department more efficient, perhaps a change in routine suggested to a worker by his own experience, is equally eligible for a cash prize.

NOT long ago, John W. Kean, civilian chief of passenger transportation for the Navy, tried a new plan to feed sailors he was transferring from Chicago to Seattle. Dining cars hitched to special trains at meal hours had proved unsatisfactory. Kean hitched a "kitchen car" to the train for the entire journey. The cost was half that of dining car or station restaurant methods. The Navy paid Kean $500 and with his plan has already saved $100,000.

A one-finger system of identification, devised by J. H. Taylor, inventor of the indestructible tag already mentioned, won him another award, this time of $500, and saved the Navy thousands. Its effectiveness may be judged from a recent incident:

At the recruiting office at Denver a man applied for enlistment with the prospect of being sent to the Great Lakes Training Camp at Chicago—a trip that costs more than $50. He yielded his fingerprint and the officer compared it with 300 cards in his file—the prints of notorious "professional repeaters" who joined the Navy only to receive transportation to some distant point and then deserted.

"Your name?" asked the officer.

"Peter Smith," replied the applicant.

"Not this time," came the retort. "You were Richard Roe when you disappeared from Norfolk July 27, and you're wanted for desertion. Your print gives you away." Ten minutes later Smith, or Roe, was traveling at Government expense—but not to Chicago.

Taylor won also a $500 bonus for his scheme of recording a vast number of fingerprints on photographic paper instead of film, slashing the cost from fifteen cents apiece to one and one third cents, and invented an infallible system to identify service men by classified records of the condition of their teeth!

FIVE women—Mrs. M. E. Smith, Miss Emily Long, Miss Pansy Willson, Miss Agnes Gallagher, and Miss Alma Davidson—have won awards for improvements in clerical work and office routine.

Is the award system worth while? Since the plan was put in effect in 1919, the Navy has distributed $50,000 in prizes and it considers every cent well spent. "The Navy takes pride in the resourcefulness of its civilian personnel," I was told by Secretary Wilbur, "and the award system has proved a stimulus from which the establishment has reaped benefits of the utmost importance."

First Woman Flies Overseas

Amelia Earhart Proves Value in Ocean Flight of Multiple-Engined Seaplane

Amelia Earhart, first woman to fly the Atlantic, looks out the door of the *Friendship* as it lands at Southampton, England.

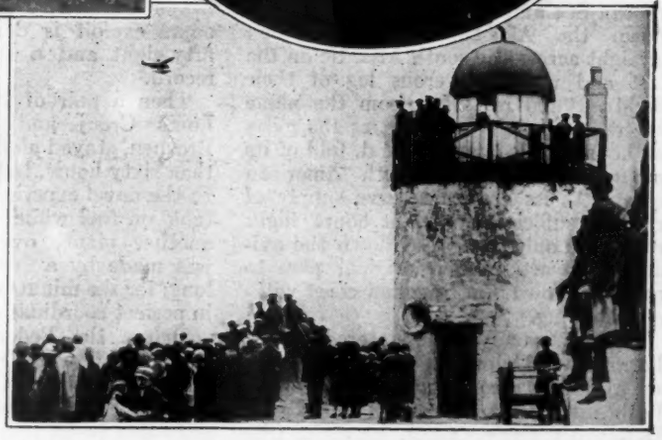
"THE flight of the *Friendship* is intended to point the road toward the seaplane instead of the land plane as a means of flying across oceans, and multiple-engined planes instead of single-engined. It will help toward more comfortable flying; when women demand planes not only comfortable, but luxurious, men will build them."

Those statements of Miss Amelia Earhart, the first woman to fly across the Atlantic, expressed the true importance of her recent flight, with Wilmer Stultz, pilot, and Lou Gordon, co-pilot, from Trepassey Bay, Newfoundland, to Burry Port, Wales. In less than twenty-two hours they flew 2,000 miles, much of the way through fog.

Their machine was a three-motored Fokker seaplane, originally designed for Commander Richard E. Byrd's Antarctic expedition.

It was the first crossing in a plane equipped with pontoons, on which to float if forced down.

Daring a journey which already had cost the lives of three women, Miss Earhart had planned herself to handle the controls, but fog, and the consequent necessity of flying by instruments alone, prevented that added glory.



The *Friendship* starting from Burry Port for Southampton. Above: Amelia Earhart, 30-year-old aviatrix, settlement worker, and business woman, who dared flight that had cost three women their lives. She says the exploit proves the superior value of multiple-engined planes.

The Fokker seaplane *Friendship* (in the air, upper left) as it was arriving at Burry Port, South Wales. Above: Southampton's welcome to the *Friendship* flyers. Miss Earhart is shown protected by police from the throng that almost overwhelmed her in its admiration for her gallant flight.

The four Super Napier flying boats, which recently flew 28,000 miles from England to Australia, are shown here en route at the Singapore Air Base. Group Captain H. M. Cave-Browne-Cave, of the Royal Air Force, commanded them.

Gains *in* Conquest *of the* Air

Rome-Brazil Nonstop Flight Sets New Air Distance Mark; Plane Refuels 5,000 Feet up to Seek Endurance Record; Soundproof Cabins and Most Gigantic Motor Are Announced

Italians Fly 4,400 Miles

BLAZING a 4,400-mile trail from Rome across Africa and the South Atlantic to Brazil, the Italian flyers Capt. Arturo Ferrarin and Major Carlo P. Delprete have just accomplished the longest nonstop flight in history. Their hop, ending on the Brazilian coast near Natal, eclipsed by 500 miles the record distance flight of Chamberlin and Levine from New York to Eisleben, Germany, made last year.

When the silver-gray Savois-Marchetti plane, the Italian tricolor on its rudder, descended it had been fifty-two hours in the air. After taking off at Rome, the airmen had skimmed over the Mediterranean Sea and the Straits of Gibraltar, down the African coast, and then straight across the south Atlantic on the last and most dangerous leg of their flight. Radio messages from the plane speeding, sometimes as fast as 135 miles an hour with a favoring wind, told of its progress toward the South American coast. At its goal, a reserve supply of gasoline sufficient for eight hours' flight remained; only fog forced down the aviators, thwarting their original plan to continue down the Brazilian coast without stopping.

In this same single-motored plane, Ferrarin and Delprete had not long before set a world's record for sustained flight. Both men are members of the Royal Italian Air Force. Capt. Ferrarin, who won a silver medal and two war crosses for his air exploits in the World War, made the first air journey between Italy and Japan in 1920, and in 1926 was a member of the racing team that defeated the United States in the Schneider Trophy race at Norfolk. Major Delprete already had one Atlantic flight to his credit; he accompanied Commander de Pinedo, as co-pilot, on the latter's four-continent air trip early last year.

Many Seek Endurance Record

FOR a while it looked as if the fifty-three-and-a-half-hour mark set not long ago by George W. Haldeman and Eddie Stinson had clinched for America the world's airplane endurance record. But it was not long to stand. Two Italians, Capt. Arturo Ferrarin and Major Carlo P. Delprete, whose latest ocean exploit is described above, flew fifty-eight and a half hours to a new record.

Then a pair of Belgian flyers, Adjt. Louis Crooj and Sergt.-Pilot Victor Broenen, stayed aloft over Brussels more than sixty hours, but refueled in the air! In the novel experiment they repeatedly took on fuel while 5,000 feet up from another plane, overhead. Connection was made by a flexible tube sixty feet long; for six minutes the two planes flew in perfect coördination.

Before the Federation Aeronautique could decide which mark to recognize as official, a pair of Germans settled the question. Flying their Junkers plane for sixty-five hours and thirty-one minutes, the other day, Cornelius Risticz and his companion Zimmermann clinched for themselves the world's endurance mark.

Deadening a Plane's Roar

THE U. S. Bureau of Standards is seeking to make flying less of a strain on the eardrums. So far the best success has been obtained, according to Dr. J. H. Dellinger, Bureau physicist, by use of cabins with four-inch soundproof walls, faced with thin aluminum sheets, lined first with a veneer of wood and then stuffed with "dry-zero"—a lightweight cottonlike substance which is grown on South American trees.

Mufflers of the motors have not been favored, since they cut the power and increase fire hazard, but experts are trying to design less noisy propellers. At present, it is said, the propeller makes nearly as much noise as the motor itself.

New Aero Motor Is Biggest

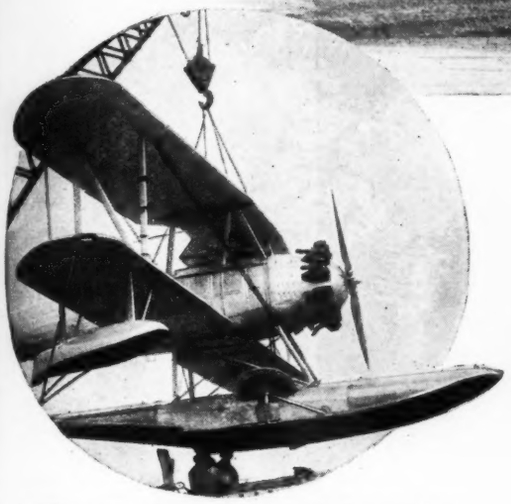
SAID to be the largest type of aero engine now in use, and differing from all others in design, a new Curtiss air-cooled motor recently tested in a standard two-passenger observation plane develops 600 horsepower from its twelve cylinders, set in two rows of six. In spite of its great power, the motor weighs but 900 pounds.

Nations Race to Lead in Air

GERMANY leads the world today in commercial aviation, with the United States so close a second that it is likely to take the lead in another year. France, Italy, and Great Britain trail in the order named. (*Continued on page 137*)

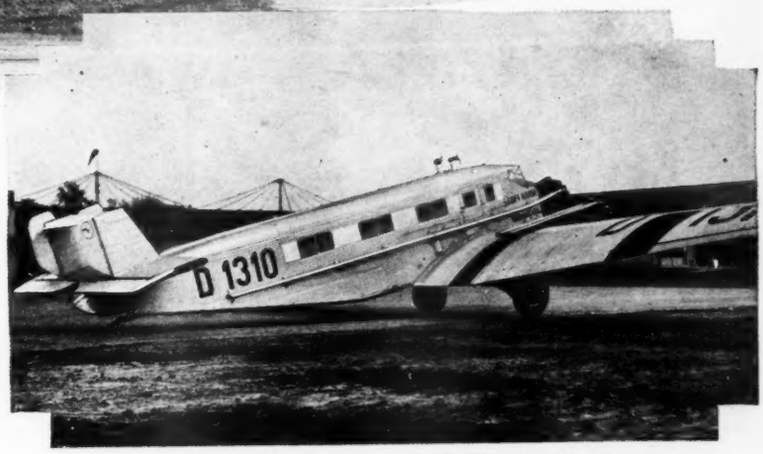
Navy's Sikorsky Amphibian

The take-off at Curtiss Field, New York, for the first trip of Uncle Sam's plane that is almost a duplicate of the *Dawn*, in which Mrs. Frances Grayson was lost attempting a transocean flight.



Plane Ready for Catapult Launching

This powerful machine, capable of landing on or taking off from either land or water, was built in the American Navy Yard at Philadelphia. It is shown on a catapult stand, ready for flight. Intended for service with the carrier *Langley*, it is now being tested at San Diego.

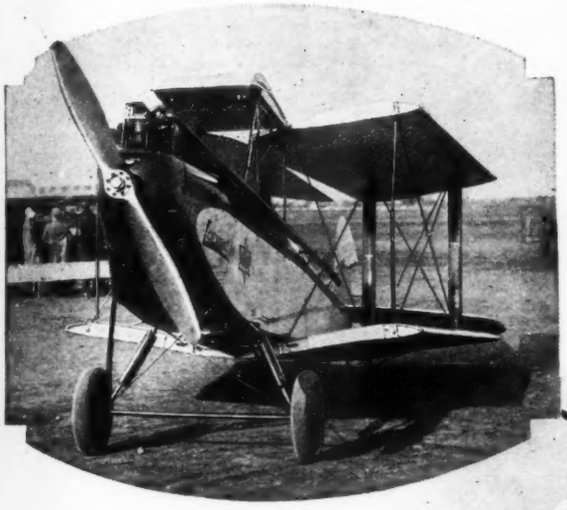


Junkers for New Nonstop Paris-Berlin Air Service

This 16-passenger monoplane with three 450-horsepower motors and exhaust pipes to carry the fumes beyond the cabin is named *Hermann Koehl* in honor of the *Bremen*'s famous pilot. It is one of the most luxurious planes of the Luft Hansa (Air League)—a merger of several early German air transport companies.

Weather Man Flies for Data

A. A. Stotts (right), chief aerographer for the Navy, who goes aloft daily, is shown here with his assistant, Lieut. W. K. Berner, and the aerograph that he takes up.



Safety Plane Flies in U. S.

This folding plane is being used at Curtiss Field, N. Y., to demonstrate the operation of Handley-Page slotted wings, described in detail in this magazine last February. They are said to prevent spins and crashes.

Auto-Giro Crashes

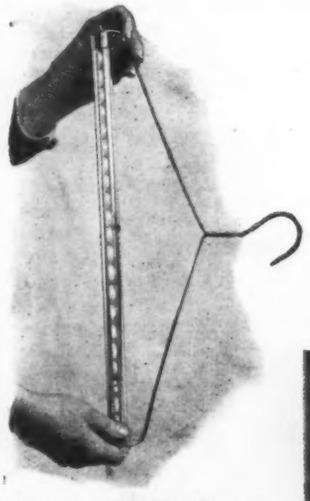
Something went wrong when Don Juan de la Cierva recently flew his famous auto-giro, a plane with "windmill" wings which can rise and descend in restricted space. The flyer survived the 30-foot fall, which occurred at an English air pageant, but the machine was damaged.

Inventions for Home Makers

You can mix a milk shake, beat eggs, or whip cream in a few seconds with a new water-power mixer that attaches to any standard faucet. And at the top of the device is a socket for inserting a small emery wheel that will put a keen edge on knives.

Seventy-five feet of drying space right in your kitchen, laundry, or bathroom is claimed for a new clothes dryer that folds up into a compact bundle when not in use. It can be set over a hot air register for extra fast drying. Later it can be used again as an ironing rack. It has two decks of wooden hangers which, hooked over the side rails, cannot slip off. No clothespins are needed to hold the garments.

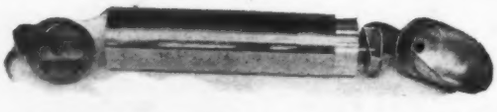
This handy tightener quickly takes the slack out of the clothesline. Simply tug at the end of the rope that has been passed through one side of the device, which grips the line firmly.



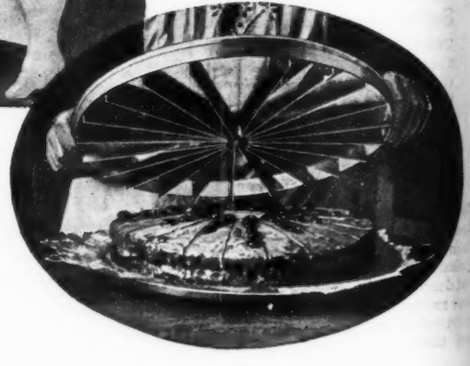
Merely by placing clothes on this new type of hanger, you protect them from moths—for the moth balls are in the hanger! Its hollow bar provides space for enough balls to project the protective scent to every part of the garment. The balls are inserted through the end of the bar, after removing one of its sliding caps.

Now the automatic electric waffle iron! All you do is pour in the batter and push down a lever. When the waffles are cooked, the heat shuts off automatically and a red light flashes. Adjustment can be made in advance for medium or well done waffles, according to your taste.

With an adjustable sleeve that fits any vacuum cleaner, this new household sprayer hooks on your machine in a second to apply lacquer or paint to furniture, or do many other household jobs by means of the machine's blower. It will spray wood stains, insecticides, floor oil—in fact, everything up to the consistency of light motor oil. A thumb trigger is used to control the spray.



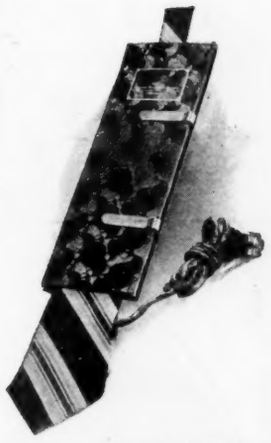
Within the hollow shell of this nickel-plated rolling-pin hide eleven other useful household utensils, including a scoop, biscuit cutter, and potato masher. In the summer time, cracked ice placed inside the roller keeps the dough cool and easy to handle.



No argument about who's getting the biggest piece of cake, when the new many-bladed cutter, shown below, is used. At a stroke, twenty-two equal pieces of cake await the hostess' knife.

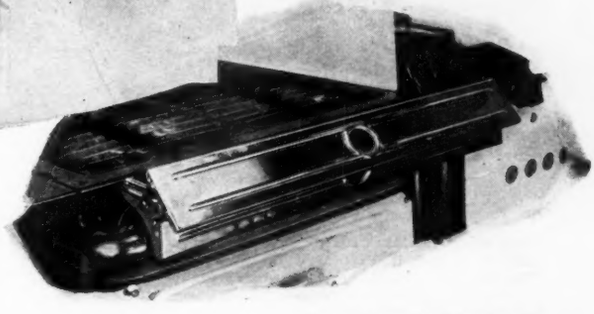
In this combination whisk broom and shoe cleaning set, a felt pad for shoe polishing is part of the handy case containing the brush. The compact kit is especially suitable for travelers.

When the meal is over, this handy steel kitchen or breakfast nook table folds into the wall, out of the way. And in a miniature wall cabinet behind it is room for more than fifty breakfast plates of assorted sizes. A sliding ironing board, concealed below the cabinet, may be pulled out for use in a moment.

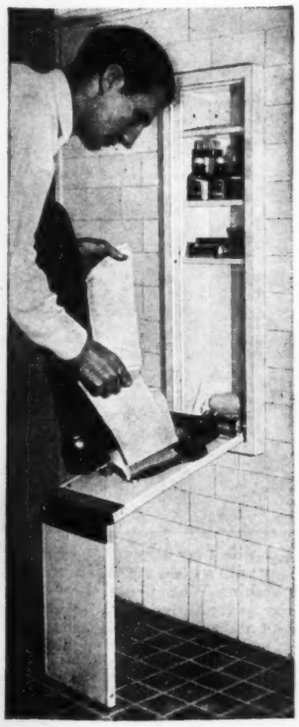


In five minutes a wrinkled tie can be restored in this convenient electric presser. An aluminum tongue is placed in the tie, which is moistened and placed between electrically heated felt pads.

Here is a special miniature ironing board for use in pressing neckties. One side of the board is faced with tin; the other is faced with felt, to prevent shine. An ordinary iron is used with the device.



Gas cocks on the kitchen range are made foolproof by a new cover that protects them from being turned on accidentally, as by catching in your clothing. It also prevents children from playing with danger. When you want to light the gas, a concealed latch at the left releases the cover and it swings back out of the way.



A shoe-shining cabinet in the wall is the latest household novelty. It contains a hinged foot rest that can be let down for instant use, as well as ample shelf room for polishes, cloths, and brushes. Closed, it becomes a white panel set into the wall, which conceals its real purpose.

Even the spring folds up in a new collapsible bed for cottage or camp. A special hand lever, operated by a gentle one-pound pressure, exerts a 1,000-pound pull to stretch the nonsag spring taut and lock it in position. The bed can be set up or folded for storage in a minute.

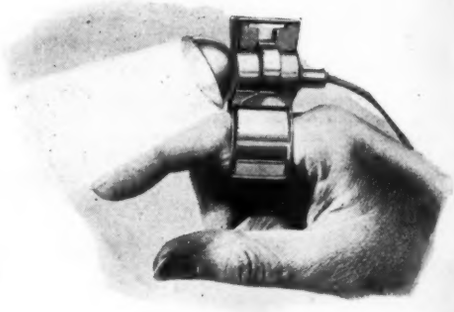
Anywhere you press it against the wall, the novel ash tray, pictured below, sticks fast until you are ready to remove it. A rubber suction cup holds it firmly in place. With such a receptacle available in the house or car, there is no excuse for dropping cigar or cigarette ashes onto the rugs and furnishings.

Always a Place for New Ideas

Even the oldest hand at billiards tries to improve his game. And so a British inventor has devised this mechanical instructor. It consists of an adjustable guide to hold the cue correctly for difficult shots, and also a mirror in which the player can watch the stroke.—Up there at the top of the page is a neat little clip holder which keeps a shaving brush in the right position for quick drying—with the bristles downward.

Now, when he takes his medicine, he doesn't have to hunt for a spoon. Ferdinand Phillipson, of New York City, has invented this metal bottle cap that has its own spoon attached. "One teaspoonful after meals" is easy, because bottle and measuring spoon never are separated.

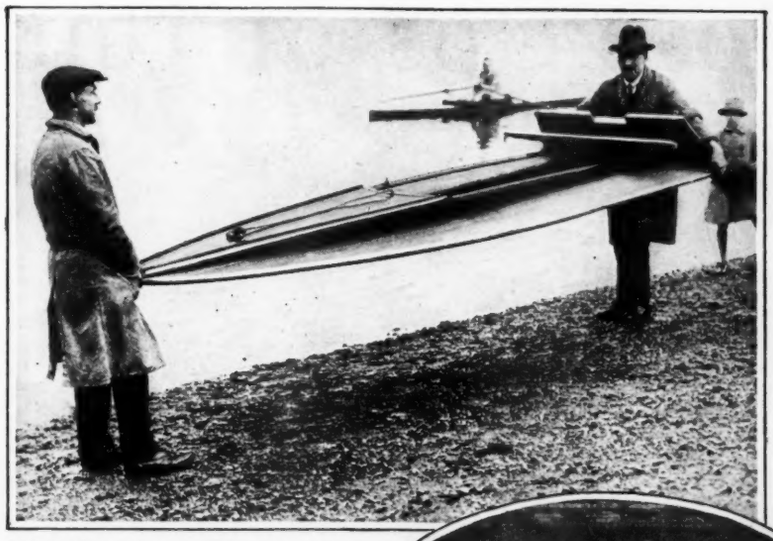
Why clamp a flashlight on the fingers? The answer is that it leaves both hands free yet can be played in any direction. And that is the idea of the ingenious invention shown at the right. It is used as an all-purpose trouble lamp.



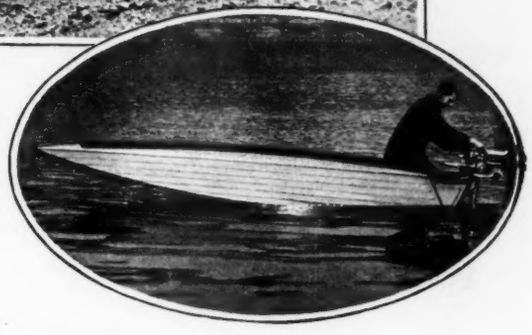
Faster than knife or shears is this novel device for cutting clippings from newspapers or magazines. Two sharp knife edges joined in the form of a spring resembling an oversized hairpin can be separated to any cutting width, so that a whole column may be clipped from a paper at a single stroke. Blades are adjusted by a small screw and stay put until they're reset.

Here's one the wife may appreciate—a new type of ash tray with a glass dish that may be removed for washing. When in use, the dish is held in place by a snap spring.—At the left is a new kind of shovel, shaped like an ice cream spoon and scientifically designed to do the hardest digging with the least effort. Pointed tip and reinforced foot plate are said to give high efficiency. It represents fifty years of research, according to the company producing it.

This safety razor blade sharpener combines both strop and hone. Both are set in the metal frame. The blade, inserted in a sliding carrier, passes first over hone surface (right), then over strop surface (left), for a fine edge.



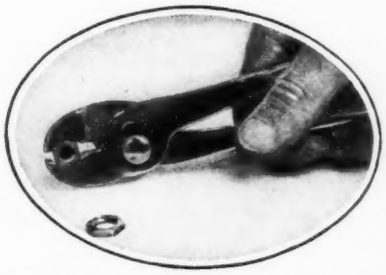
Light and compact enough to be carried on top of an automobile and handled by two men, this ingenious folding motor boat weighs only 160 pounds. It is made of hardwood, so jointed that the sides and rear end will collapse when screws and locks are turned. Driven by an eight-horsepower outboard engine, it traveled at the speed of thirty miles an hour in recent trials on the Thames River.



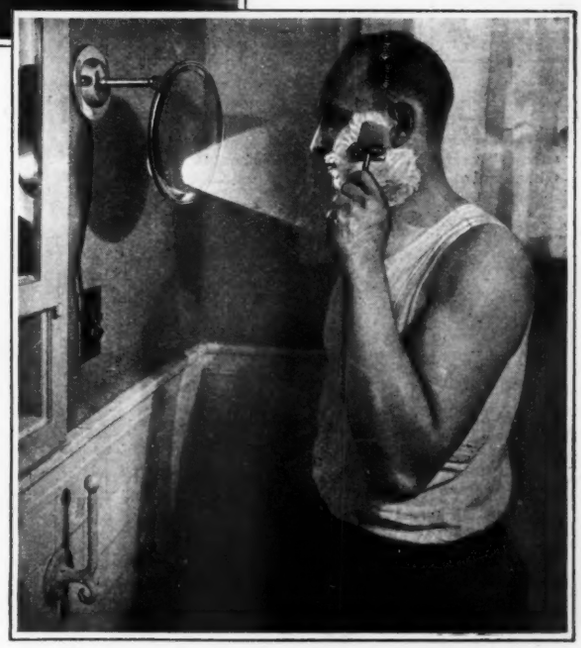
Invented for musicians who travel, the curious practice violin above offers two advantages. Minus sounding board, its muted tones will not disturb others in hotel or apartment house. Then, it can be taken apart without damage and reassembled in half a minute's time.

To provide proper illumination while reading in bed or some out-of-the-way nook, the little lamp shown at the left can be clamped to any book. It weighs only about three ounces and can be plugged into any electric light socket. A shade throws the light on the pages of the book.

This healthy young man is enjoying his daily sun bath, clad in an open-work suit designed by the U. S. Bureau of Home Economics to admit the beneficial ultra-violet rays contained in sunlight.



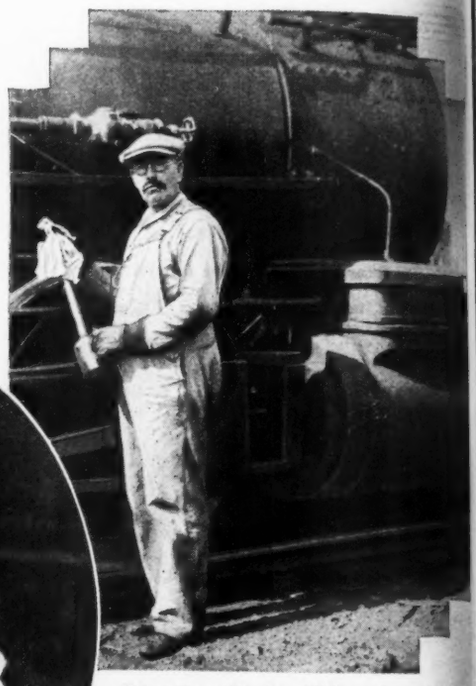
With jaws that fit the corners of hexagonal nuts, this combination of wrench and pliers is designed to grip any nut firmly without slipping and without chewing the corners. It is a handy tool for motorists to carry.



Shaving by spotlight is the latest idea for speeding up the daily chore. Light from an electric lamp attached behind the mirror is focused on the face by a lens inserted in the lower part of the mirror. A ball and socket joint makes it possible for the shaver to direct the light beam to any portion of the face desired.

Close-Ups of Unusual Men

Outside the physics laboratory Dr. A. A. Michelson, of the University of Chicago, famous for his measurements of light, turns to art for recreation. Here he is with his water colors.



Meet Dave Dingler of Missouri, president of the Cassville and Exeter Railroad and engineer of its only locomotive, which hauls one car over five miles of track.

Mechanic and astronomer, William R. Ludewig directs machine shop instruction at the University of Pittsburgh, and lectures in astronomy at the Allegheny Observatory.

By inventing a new single-strand type of cable for submarine mines, Sergt. Paul R. Nelson of the Coast Guard will save Uncle Sam a million dollars in ten years.

One man does the work of ten with the bottle-sealing machine invented by Percy W. LeDuc, chemist in the U.S. Department of Agriculture, thereby saving $12,000 a year.

Champion slate splitter of America is the title claimed by Dell Williams, of Bangor, Maine. In a recent contest he split forty-eight perfect sheets of slate from a one-inch block. His tools—mallet, chisel, and briar pipe.

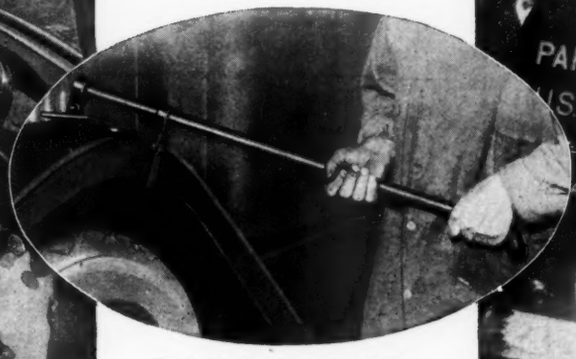
Capt. Charles J. Van Amburgh (center) is firearms expert for Massachusetts, the only state that employs an authority to solve criminal cases by the scientific examination of identifying marks on bullets and weapons.

Making It Easier for the Motorist

This motor car is crashing into a tree at a speed of 30 miles an hour without suffering damage. The protection is in the bumper, a new German invention made of rubber by a secret process which gives extreme elasticity and toughness.

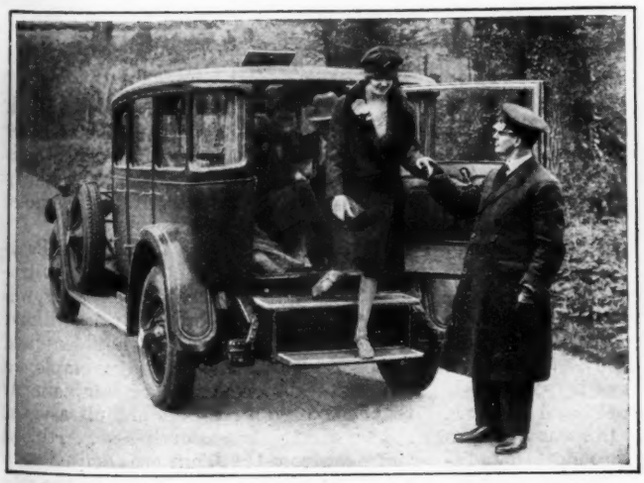
Skidding is said to be prevented by this wide, metal wheel with deep grooves, which bites into the ground or grips with a force of 1,500 pounds. The wheel is carried on a fork so the driver may lift or apply it by throwing a lever.

By means of this compact device, just invented for new Ford cars, both starter and choke can be operated with one finger. The attachment, when in place, is only eight inches from the wheel and is easily installed.

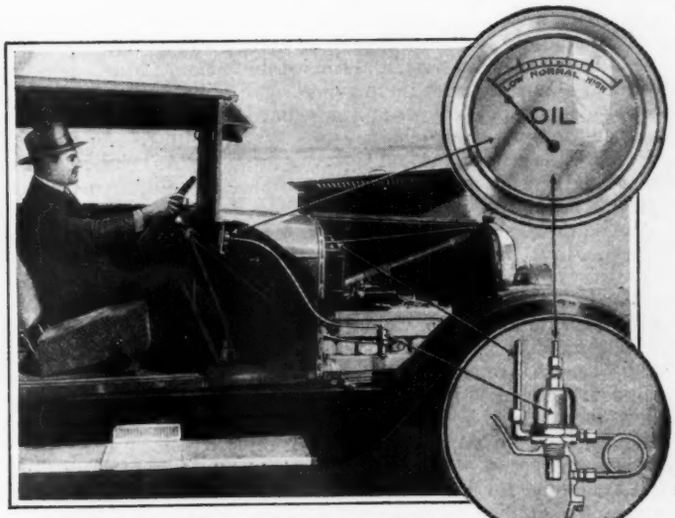


With this handy tool a sliding hook grasps the bent edge of a fender and leverage pulls it straight. A leather pad prevents marring the paint. A hook on the other end of the device straightens bent fender flanges.

This new "automotive mail box" is designed to prevent traffic delays caused by drivers who park while they mail letters. It is being tried successfully by the Baltimore Post Office. A lever opens the letter slot.



A new "observation car" automobile body enables rear-seat passengers to view the country as from a railroad observation car and, incidentally, discourages "back seat driving." The door is conveniently placed at the back and folding steps are provided. The car is an English invention.



An accurate gage that indicates on the dashboard of your car the exact condition of your oil puts an end to the necessity of renewing oil in the crank case on the basis of mileage. The photograph and the drawings show how the gage is connected with the crank case.

The Month's March in Science

Two Victories Over Pests

WEAPONS and inventions of modern warfare have been brought into action recently in two decisive victories on land and sea over destructive pests, age-old enemies of man.

After years of experimenting, Uncle Sam's Chemical Warfare Service has at last developed a successful defense against ship borers, the submarine destroyers which undermine wharves and which, it is said, have destroyed more wooden ships than all the naval battles in history. The new weapon is a poisonous chemical solution, a derivative of the high explosive Lewisite. Applied to the pilings of wharves, it destroys the armies of sea worms.

In Palestine this summer, an invading host of locusts was driven back by flame guns and poison sprays. Since ancient times these insects have periodically ravaged the Palestine crops, bringing famine. This year scientists and military men rushed mobile field units to meet the enemy. First powerful portable lamps were used to attract the insects into traps. Then the flame guns and poison sprays were brought into action, slaying the locusts and their unhatched eggs.

Often it has been said that insects are man's worst enemies. It is requiring deadly inventions of human warfare to defeat them.

New Gains by Medicine

THE health of the world is improving, and the gain is most marked in America and Europe.

Such is the encouraging word of Dr. Hugh S. Cumming, Surgeon General of the United States, after attending the 1928 meeting of the Health Organization of the League of Nations at Geneva. Among the reasons, he says, are closer international coöperation among health authorities, improved sanitary conditions, the spreading of health information with responding public interest, and the establishment of a world-wide intelligence service to warn against plagues and safeguard against the spread of epidemics.

Meanwhile physicians and surgeons are attacking disease more relentlessly than ever. The newest phase of this attack, says the distinguished surgeon, Dr. William J. Mayo, is the closer study of the chemistry of the human body. In the past he says, "medicine has attempted to cure or ameliorate disease by combating its gross manifestations." Now, however, medical men are turning attention to chemical changes within the body that allow disease to gain foothold. This, he believes, opens a new line of attack on disease—cancer in particular.

It remained for Dr. Samuel W. Parr, professor of applied chemistry at the University of Illinois and president of the American Chemical Society, to point out recently that the prevalence of the common cold may be due to poison in soft coal smoke. More than four hundred billion cubic feet of sulphur dioxide gas, he said, is poured yearly from the nation's chimneys. Dr. Parr urges organized research to determine the effects on public health.

Marconi Has New Project

WHENEVER Marconi sails on one of his cruises in the yacht *Elettra*, the world looks for some advance in wireless. It was not disappointed when, returning recently to London after his latest voyage, he announced that he was working out an improved method of beam transmission which will widen the range of world communication.

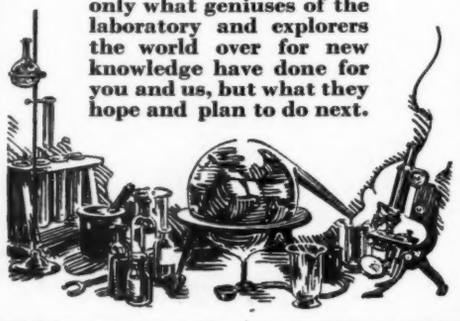
At present a beam of radio waves can be focused only in one prearranged direction. Marconi proposes now to arrange the apparatus so that the beam can be shifted by the operator, like a searchlight, to any part of the world.

"As beam stations are fixed at present," he said, "America cannot be turned on to Japan, nor India to Russia or the North Pole. Where there is a revolving beam, if you want to transmit it to a certain country, you merely direct the beam toward that country."

One of the mysterious freaks of radio—that is, the occasional ability of metal objects to give forth broadcast music without the presence of a receiver—has been the subject of recent investigation. Not long ago an elevator signal box in a building at Des Moines, Ia., was heard to emit music from a local broadcasting station. A telegrapher in New Jersey was amazed to hear his instruments talk and sing. In a Swedish village store, folks thought they heard spooks when a shovel on the wall repeated everything broadcast from a near-by station.

The explanation of experts is that each of these loudspeaking objects chanced to be close to an electric power line connected with a broadcasting station, and that each object was set into vibration by powerful electric impulses passing over the line. Much the same thing happens when the diaphragm of a telephone receiver is set into vibration by electric impulses in a telephone wire.

LATEST discoveries, inventions, and theories in the various scientific fields that are of prime importance because of their bearing on the affairs of our everyday life are recorded each month in these pages. Here are presented not only what geniuses of the laboratory and explorers the world over for new knowledge have done for you and us, but what they hope and plan to do next.



Most Mishaps Avoidable

A WORKMAN at a cutting machine was disturbed over a quarrel with his wife. In a moment of distraction he forgot the knives and a serious accident resulted. Another man, operating a huge press, was worrying over a mortgage on his home. Failure, for an instant, to attend to his job nearly cost him his life. Looking out the window at a girl who was passing on the street caused a mechanic in an automobile factory to make a costly error which lost him his job.

An analysis of 75,000 industrial accidents, recently completed by H. W. Heinrich of the Travelers Insurance Company, revealed, he says, that a workman who is mentally disturbed is as much of a danger to himself and his fellow workmen as if he were physically disabled. Factory foremen, he adds, would prevent accidents by studying their men for signs of mental distraction. Of the 75,000 accidents analyzed, he declares, at least ninety-eight percent could have been prevented.

In Germany motion pictures are being used to study mental disorders. In a room where the patient has been left alone a hidden and noiseless camera records his behavior and expression. Later the films are studied by experts.

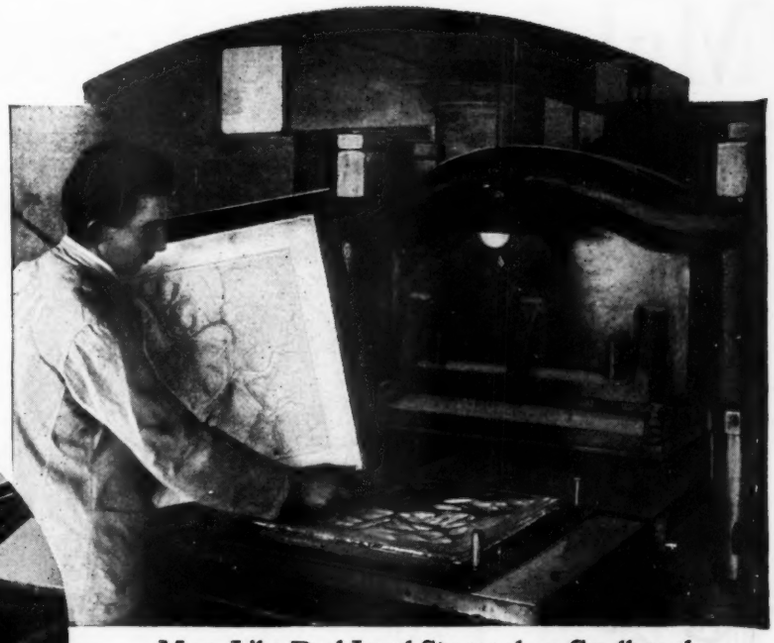
Psychology, a young science, is being applied in increasingly valuable ways.

Measuring Sunburn Rate

HOW long can you lie on the beach without being painfully sunburned? Many a bather has experimented, to his sorrow, to find that his skin is surprisingly sensitive to the penetrating ultra-violet rays of sunlight.

But now Dr. Robert C. Burt, of Pasadena, Calif., has invented a new instrument which, in a few minutes indoors, will tell just how easily you sunburn—without the chance of blistered shoulders and sleepless nights. The apparatus employs a quartz tube mercury vapor lamp similar to those used in producing ultra-violet light in the treatment of disease. Artificial sun rays from the lamp are focused on a small area on the bare skin, and the rate at which this skin burns shows how sensitive you are. From this you can tell how long you can *(Continued on page 131)*

Machines Cure Colds and Sleeplessness — Marconi Tells Plans for New Beam Wireless That Will Move Like Searchlight—Young Students Make Diamonds From Old Stick of Carbon



Maps Like Real Land Stamped on Cardboard

A metal die, cast from an original map made of plaster, stamps the pliable cardboard. A map is seen above leaving the hydraulic press.

Relief Maps Made by Machinery

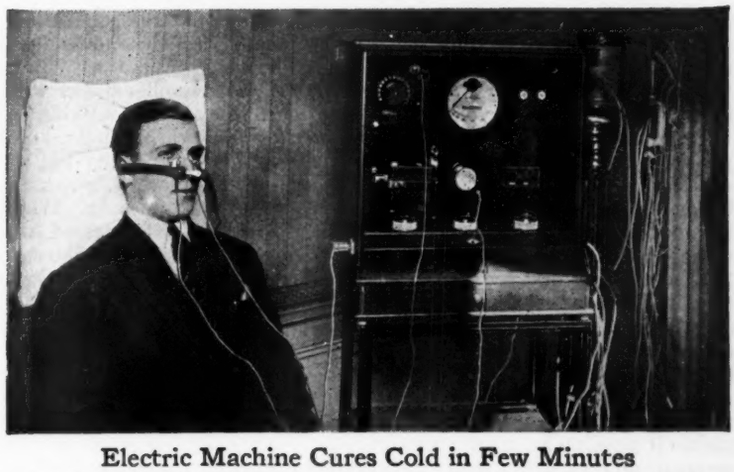
An artist retouching and coloring a map in Germany made by a process so inexpensive that every class and almost every child may have one.

Machine Beats Soporific Drugs in Producing Sleep

Dr. Hans Salomon, of Berlin (holding watch), whose device produces a hum that put girl at right to sleep while the other, who took a drug, remained awake.

Twin Boy Students Make Diamonds

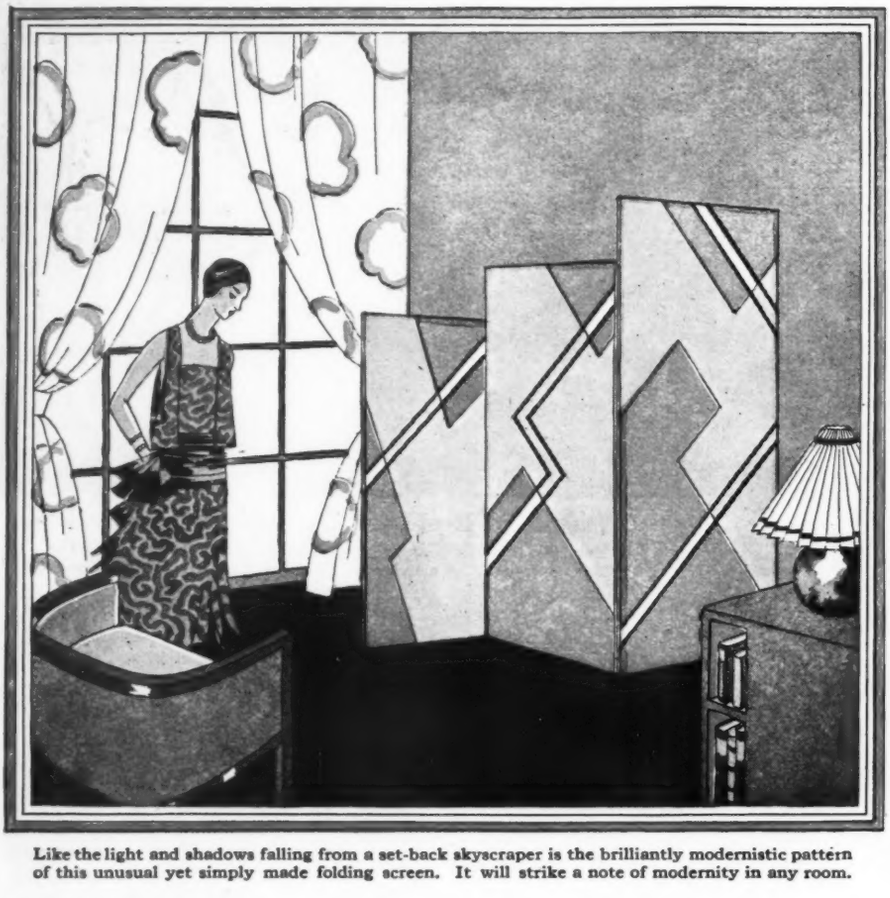
From an old stick of carbon, Gordon (left) and Everett Gravenhorst, schoolboys of Brooklyn, N. Y., shown with some of their apparatus, have made a pair of microscopic diamonds.



Electric Machine Cures Cold in Few Minutes

Prof. Bordier, University of Lyons, France, is seen here demonstrating his device that applies to the nose tiny plates which send high-frequency current into the inner tissues, relieving the congestion and killing the germs that are the cause of the cold.

Making Modernistic Screens



Like the light and shadows falling from a set-back skyscraper is the brilliantly modernistic pattern of this unusual yet simply made folding screen. It will strike a note of modernity in any room.

MODERNISTIC furniture is so stimulating as to take one's breath away. It is at once severe and angular, crystalline and scintillating. You may not like it at first, but it grows upon you and often ends in fascinating you.

Folding screens decorated in the modernistic manner offer the amateur craftsman an especially easy and natural way in which to introduce the new mode into his own home. They can be placed in rooms containing period or commercial furniture without upsetting the harmony of the decorative scheme. At the same time, if the colors are happily chosen to suit the surroundings, they will add a brilliant touch of modernity.

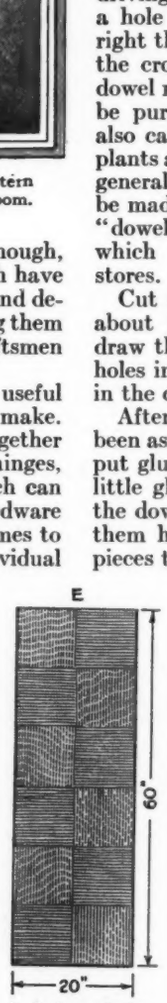
"But I cannot see any rhyme or reason in these new styles," you may object. Perhaps not, but that may be because you have not paid much attention to the exhibitions, window displays, and advertisements of furniture and accessories in the modernistic style. The truth seems to be that those who are the most skeptical when they first see the new designs become later on the most enthusiastic about them. That is because the style is characteristic of the time in which we live—the machine age.

It is the added leisure which machines and mass production have given us that makes it possible for many of us who are mechanically or artistically inclined to buy a few tools and arrange a workshop in which to gratify our inherited instinct for manual activity. Strangely enough, we can take the very designs which have been planned for mass production and derive the keenest pleasure in applying them to pieces we make by hand like craftsmen of old.

Folding screens, besides being useful and decorative, are very easy to make. Three or four frames are hinged together with what are known as screen hinges, that is, double-acting hinges, which can be obtained from the larger hardware stores. These hinges allow the frames to swing in either direction. Each individual frame consists of two vertical and two, three, or four horizontal pieces, depending upon the height.

Your lumber dealer will have in stock wood suitable for the frames. The sidepieces, or stiles, can be ¾ or ⅞ by 1½ in. and the crosspieces the same thickness and 3 in. wide. When plywood or stiff pressed wood is used as a covering, the stock for the frames can be as thin as ½ in. The size of the completed screen depends mainly upon where and how it is to be used and partly upon the design. Threefold screens with panels 20 in. by 5 ft. or 5 ft. 6 in. are generally satisfactory, as are fourfold screens with panels 15 in. wide.

The advanced woodworker may join the frame members with mortise and tenon joints, but for the man or boy with limited experience the dowel construction illustrated on page 109 is much easier and quite satisfactory. The most important requirement is to lay out all pieces of similar length at the same time and cut their ends absolutely square. A miter box, even if only a cheap wooden one, is a great help in making square cuts.



A design of the more conservative type, yet quite modern in spirit. Use three similar panels.

FIRST nail together the sides and the top and bottom pieces of each frame. Use thin finishing nails about 2½ in. long and drive two nails into each joint, spacing them at the outside as if there were to be a third nail driven between them. Allow their heads to project sufficiently to be easily withdrawn. Now, instead of driving the third nail between them, bore a hole with a ⅜-in. (No. 6) auger bit right through the sidepiece and well into the crosspiece. Insert a ⅜-in. wooden dowel rod in this hole. Dowels often can be purchased in hardware stores; they also can be obtained from woodworking plants and cabinetmaking shops and large general mail order concerns. They can be made, too, by using either a so-called "dowel plate" or a dowel turning tool, which is sold by the larger hardware stores.

Cut off the dowel so that it projects about ¼ in. from the sidepiece. Withdraw the other nails one at a time, bore holes in their place, and insert dowels as in the center hole.

After all the joints of the frame have been assembled in this way, take it apart, put glue on the edges to be joined, let a little glue run into the dowel holes, dip the dowels themselves in glue, and drive them home. Glue the top and bottom pieces together first; then insert the middle pieces.

If one or two carpenter's bar clamps or improvised homemade clamps of any kind are available, they will be useful in making tight joints. Small blocks with a ½-in. hole in the center should be placed over the projecting central dowel in each joint, so that the pressure of the clamp will be transmitted directly to the frame and not to the dowels. When the frames are dry, the projecting dowel ends are sawed off, and the joints are smoothed with a plane.

The frames may be covered with a variety of materials, depending upon how they are to be decorated—fiber wallboard, pressed wood, plywood, imitation leather, burlap, parchment,

How You Can Construct, Without Straining Your Pocketbook, the Popular Ultramodern Pieces

fabrics, wall paper, oilcloth, Japanese wood paper, metal foil or leaf, sheet metal, or what you please.

Several designs are illustrated and more are shown on Popular Science Blueprint No. 91. You will find this blueprint, which can be obtained from the Blueprint Service Department for 25 cents, of considerable assistance in making any one of these screens because the drawings are much larger than any which can be reproduced in the magazine. The blueprint also contains a complete bill of materials, list of tools, and outline of operations.

All but one of the screens illustrated on these pages and shown on Blueprint No. 91 were designed by Herman Hjorth, one of the country's leading teachers of woodworking, in collaboration with William H. Varnum, Associate Professor of Applied Arts at the University of Wisconsin. The exception is the screen represented in the larger illustration on this page. This screen is the work of J. Warren Campbell, a New York designer, and is similar to one which created much favorable comment recently at an exhibition of the Teaneck (N. J.) Guild of Artists.

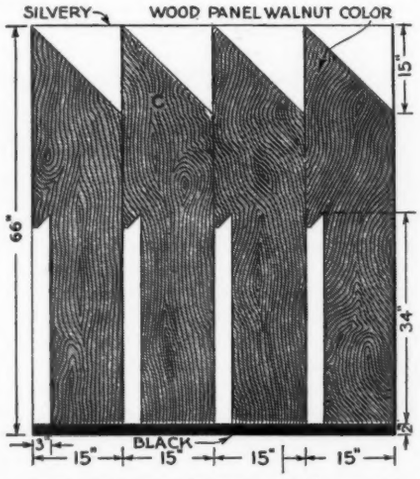
By striking off the top of each panel at an angle, the designer of this most original screen has heightened the strong, dynamic effect. It makes a vivid piece for use with other modernistic furniture.

THE first screen—the one appearing in the larger illustration on page 58—may be painted in the colors indicated or any suitable color scheme. As originally designed, the covering was blue imitation leather, with black lines and gilding to complete the decoration. Brushing lacquer can be used for the black or other applied colors; and gold bronzing powder mixed with banana oil or bronzing liquid, for the gilded areas.

One method of getting the lines of the design absolutely straight is to apply gummed paper tape to the edge of each contour to serve as a mask, and then paint one color, letting the brush overlap the edge of the paper. When the surface is thoroughly dry, dampen the paper sufficiently to allow it to be removed, wash off any surplus gum, and apply more tape, laying the edge over the areas already painted so as to mask them.

Another way of obtaining a straight, true line is to use a tool called a "painter's timesaver." This consists of a piece of thin metal shaped in such a way as to resemble an inverted dustpan. It is held right on the line and the strokes of the brush overlap the edge. This tool is sold in many paint stores.

The screen may be finished by fastening a strip or gimp of the blue material around the edges with fancy brass nails. If preferred, the edges may be painted black, blue, or gold.



A plywood-covered screen with the natural wood grain forming most of the surface.

It will be noted that the decoration of this screen is suggestive of the light and shadows that fall from a set-back skyscraper on the wall of an adjoining building.

The screen illustrated below it, which is marked *E*, can be made in various ways. One is to cover the frames with smooth fiber wall board on both sides and paste on squares of Japanese wood paper or any fabric or paper which gives the effect of fine parallel graining. Even a slight difference in the markings or texture will be sufficient to set off the squares when they are arranged alternately as shown.

The color scheme of the third screen (that designed by Mr. Campbell) is blue, red, and black on a silver background, although all these could not be shown in the reproduction. The base, which is black, is ornamented with a very flat hand-carved molding picked out in silver and red. Obviously, the base could be omitted, or simplified by merely painting on the ornamentation instead of using a molding. The fourth screen (that marked *C* on this page) is made by fastening plywood panels to the face of each of the four frames.

THE plywood, if birch, whitewood or other light colored wood, is stained a light walnut color except for a 2 in. wide strip at the bottom, which is either stained or lacquered black. Silver powder mixed with bronzing liquid is then applied to the wood as indicated. The back of the screen can be lacquered or stained in any inconspicuous way.

Another method of making screens is to stretch burlap tightly over the frames and give it a sizing coat of very thin shellac. After that a coat of gold bronze is applied and any suitable floral design painted on freehand. One such design is shown on Blueprint No. 91. A gimp of harmonizing color or of black or gold is fastened around the edges with black or green metalene nails. A simpler method is to apply a high grade wall paper to frames covered either with burlap or wall board.

It will be understood that these are merely suggestions. If ¼-in. plywood or fiber board is used for covering the frames on either one or both sides, it should be nailed in place with ⅝-in. brads, which should be set below the surface with a fine nail set. The edges must be planed and sandpapered (*Continued on page 109*)

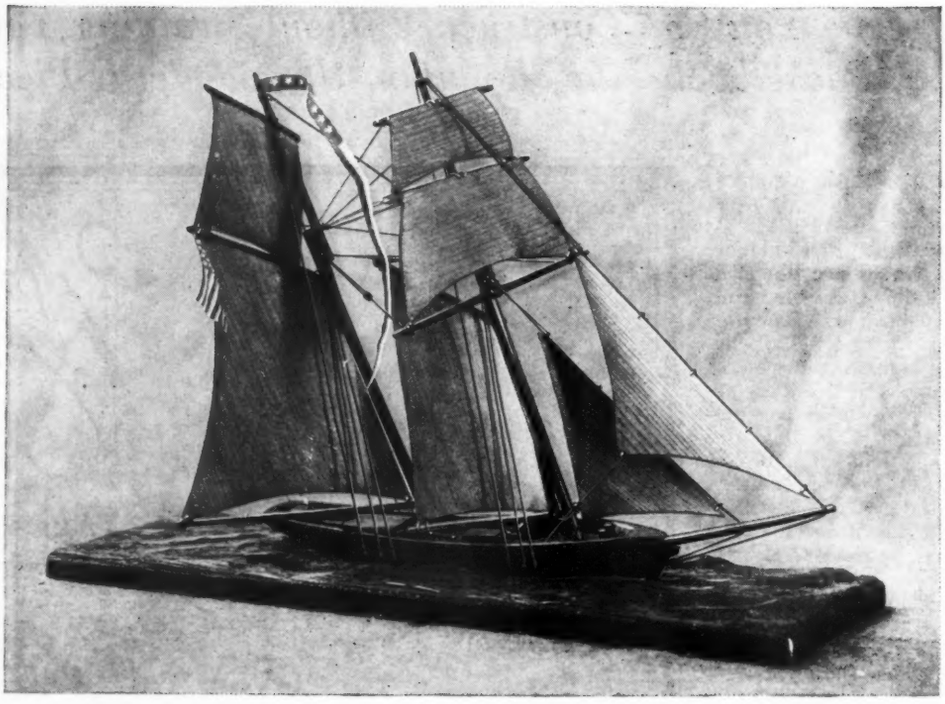


Fig. 1. Small and very simple model of a rakish Baltimore clipper. The sails are of wood.

How to Whittle a Ship Model

A Few Scraps of Wood, a Knife, and a Shady Seat Outdoors Are All You Need to Make This Privateer

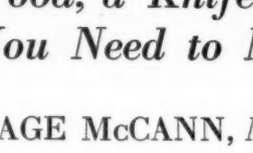
By E. ARMITAGE McCANN, *Master Mariner*

BECAUSE the weather is hot and we wish to be outdoors, it does not necessarily follow that we must discontinue our ship model making. We can follow the example of the old-time sailorman who gathered some scraps of deck planking and sat on the fore hatch and whittled a model of his ship. He could make the hull, spars, sails, and everything of wood, with just a few threads of rigging added to give the model an appearance of completeness. And we can do the same. Indeed, some who may have considered the work on our previous scale models a bit tedious, will find more pleasure in making a small and very simple model.

I made the one illustrated in Fig. 1 with a hull 5½ inches long, which gives a model 8 by 6 inches over all. Of course, it could be made larger or smaller.

You have often read about "long, low, raking craft" in pirate and privateer stories. This is a model of one of them—a picturesque Baltimore clipper of about 1812. Some of these craft were as long as 100 ft., and their rig was that of a topsail schooner. They carried a heavy press of canvas and were the fastest craft afloat.

As with all ship models, it is desirable to work from full size drawings. These you can obtain by sending twenty-five cents to the Blueprint Service Department of POPULAR SCIENCE MONTHLY for Blueprint No. 92 (see page 102).



For wood to make the model, I went to the scrap box and picked a bit of oak for the base, rosewood for the hull, amaranth for the deck fittings, hazel for the spars, and yellow cedar for the sails. These give contrast and color without the use of paint or stain. It is not necessary, however, to use these or similar woods. The hull can be made very easily of white pine and will look well if either lightly varnished or painted in realistic colors.

Figure 3 shows the shape of the hull. The whole hull is given so that those who prefer to make a model to be set in a cradle, instead of merely a water-line model, can do so. Those who wish to copy my model, however, will make the hull only as far as the cut-off line, which is marked *C*. For this a piece of wood ⅝ by 1¼ by 5¼ inches will be required.

Mark a center line around this—top, bottom, and ends. On the top mark the bulwark line, which is the outer line (marked "deck outline") on the half-breadth plan. On the bottom of the block mark line *C*, as in the half-breadth plan. Shave the wood down to these two curved lines and cut the two ends to the profiles which appear on the sheer plan. Then cut the top of the hull to the slightly hollow sheer line.

To do the rest of the whittling you will be guided by the body plan, which shows the cross-sectional shape of the hull at the various station points, which are marked from 1 to 8 and are ⅝ inch apart, measured from the stern.

The stern and the sternpost may be left on or they may be ignored at the time the hull is whittled and added later, together with the rudder.

NEXT hollow out the top of the hull to the deck, leaving the bulwarks standing. A small chisel is an aid in this, and the finishing can be done here, as everywhere, with coarse sandpaper followed by fine.

The whole model can be made easily enough with a jackknife; on the other hand, it can be constructed almost entirely with machine tools. A happy medium is the best to choose; that is, a saw for roughing out, a chisel for such processes as that just mentioned, a flat gouge to hollow the sails and carve the waves on the base, and a fine twist drill or awl. The advantage of this model, however, is that if you are working outdoors you can get along with nothing more than your pocketknife.

(*Continued on page 114*)

Outboard Racing Secrets

How to Coax More Miles an Hour from a Light Motor Boat—Fuel, Lubrication, and Ignition—Hints on Choosing Both Hull and Power Plant

By NEWCOMB LEONARDE

SPEED—how to get more speed—is the topic of the day with the outboard motor boat owner. In the past few years the speed possibilities of these little craft have increased so rapidly that today it is not unusual to hear thirty miles an hour talked of, whereas a short time ago the utmost expected was ten or twelve.

A large part of this increase in speed is due to better designed hulls. The rowboat of flat-bottom vintage is no longer good enough, for the outboard motor manufacturers have given us power plants that call for the best the naval architect and boat builder can design and construct.

How to get the most speed out of an outboard motor is not alone a question of fuel, lubrication, and ignition. The "speed bug" must provide himself with a well-designed speed type hull, either V-bottom or step hydroplane, both of which have their ardent supporters among experts.

As to the size, it may be anything from the little eight-foot scow type to the sixteen-foot sea sled, and the cost may be anywhere from twenty-five dollars to four or five hundred. Each calls for a particular type of outboard motor, for the sport has developed "classes" just as in the larger speed boats. For the higher speeds, the larger motors are an absolute necessity; and it takes one of the eight-horsepower motors to drive a twelve- or fourteen-foot boat along at from twenty to twenty-five miles an hour. The large "twins" or the new four-cylinder motors are required to get a speed of thirty miles or more.

FOR illustrative purposes we will assume that you have just purchased one of the high-powered twins. As nearly all the outboard motors are of the two-cycle variety, in which good compression is most important, you will need to take particular care in breaking it in. Twenty or more hours of steady running at moderate speed will be needed.

Do not under any circumstances forget to give it plenty of oil at this time. Even if spark plugs do foul and have to be changed, ample lubrication during this breaking-in period will do more to insure good results later on than any other one thing you can do.

Winning boat in a recent "free for all." It will do 22 miles an hour with a Class-B motor and 30 if more heavily powered.

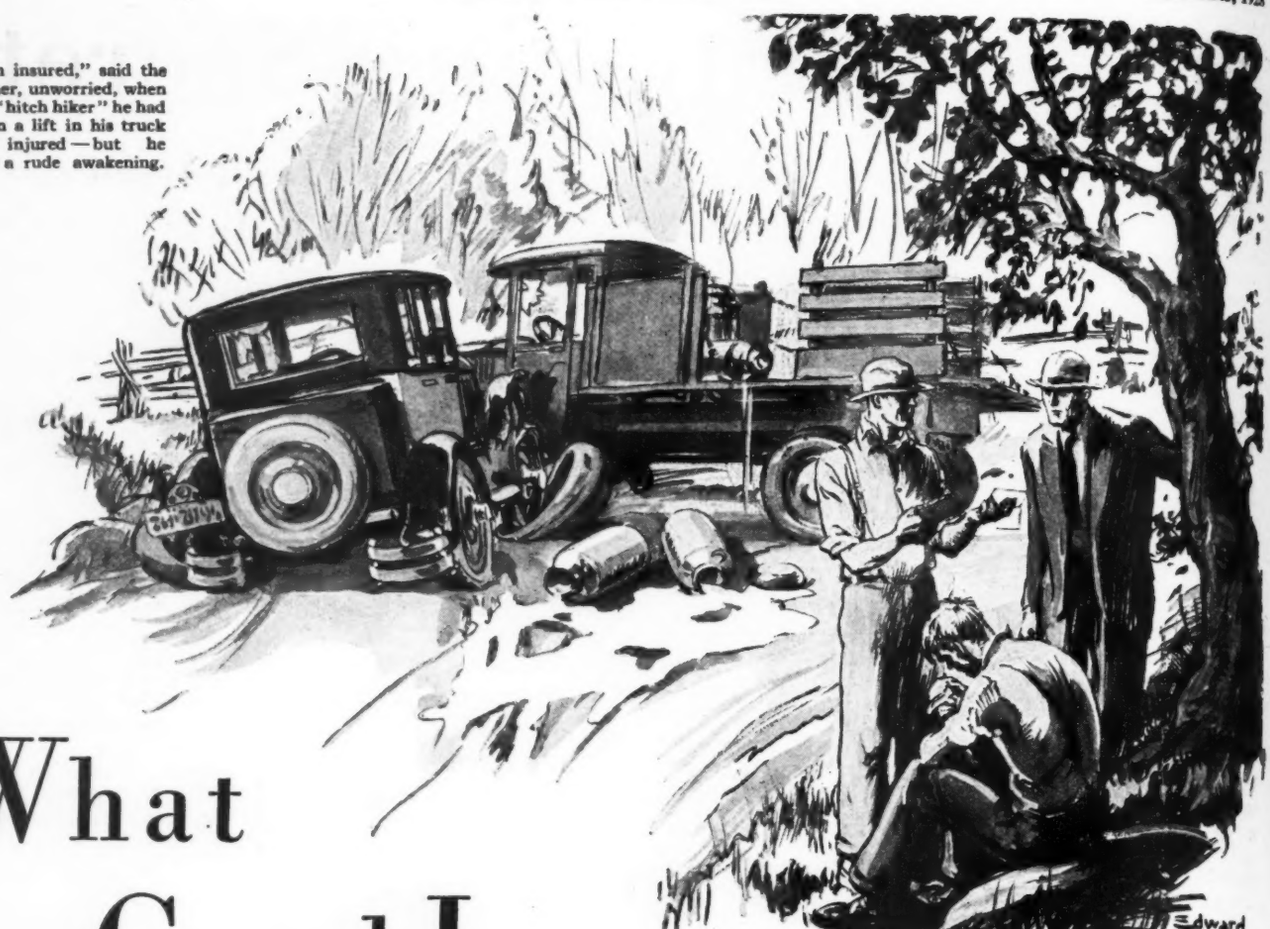
A pint of oil to each gallon of gasoline is the usual proportion, and they should be well mixed before being put in the motor tank. As much as a quart of oil to each gallon is often used for the newer and larger motors. A high-grade medium gas engine oil should be used. Most manufacturers recommend for their motors a particular brand. Some advise castor oil for racing. This undoubtedly does give better lubrication for maximum speeds. It should be remembered, however, that castor oil will not mix with gasoline, so it must be fed through a drip cup.

High-test gasoline is, of course, a necessity if one expects the utmost speed of which the motor is capable. Some racing drivers dope their gasoline with ether (sulphuric motor ether) or benzine and believe that they get a little more power. A well-tried speed mixture is seven quarts high-test gasoline with one half pint of ether and the amount of oil called for in the manufacturer's directions. Personally I prefer straight high-grade gasoline.

Carburetor adjustment must be studied if the operator expects top-notch results. It must be remembered that the carburetor adjustment on a two-cycle motor is quite different from that on the four-cycle motors used in automobiles. The adjustment must be quite rich for starting purposes, but after the motor has warmed up, the needle valve should be turned down. A good way to tell whether your motor is turning up at its maximum speed is by using a tachometer. This insures the right explosive mixture to give best results and highest speed. Since there is compression in the crank case of a two-cycle motor, it must be realized just how important are tight crank bearings so that no excess air may leak in or out.

AND this brings up the question of ignition. Some motors use magneto ignition only, some battery only, and some a combination. Whichever your motor has, it is important to see that the spark plugs are clean and the gap adjusted exactly according to the directions. The magneto contact points or battery breaker points also should be adjusted to a nicety with a feeler gage. The usual gap on magneto-fired engines is .016 in., and on battery-fired motors .010 to .012. Of course, all ignition parts should be kept dry and free from oil.

Not the least important detail to be watched is the straining of the gasoline. It is not enough to strain it through the gauze of the (*Continued on page 92*)



"I'm insured," said the farmer, unworried, when the "hitch hiker" he had given a lift in his truck was injured — but he had a rude awakening.

What Good Is Automobile Insurance?

Sometimes It Protects You and Sometimes It Doesn't, And This Article Tells Why—How to Study Your Policy

By CARL HELM

THE day was boiling hot. A sympathetic farmer, driving his truck home from town, stopped to pick up a weary "hitch hiker." A few minutes later the truck collided with another machine and the hiker was injured. He sued for $10,000 damages.

"I'm insured," said the farmer, unworried. "The company will take care of it." He sent the court summons along to his insurance agent. But the company replied:

"Your policy was for a commercial vehicle, and when you carried a passenger you automatically relieved the company of all liability for accident damages. Sorry, but you will have to stand the consequences yourself!"

"But I wasn't carrying this fellow for hire," the farmer protested, going to his lawyer. "I was only giving him a lift." The attorney read the insurance policy through until he came to this paragraph:

"This policy shall exclude any obligation of the company as respects bodily injury to any passenger while an automobile described as 'Commercial' is being used for passenger-carrying purposes, regardless of whether or not a compensation is charged."

Suppose that accident had happened to you. Have you ever read your policy through carefully? Do you know what you are "covered" against and what you are not?

LAST year 21,000 men, women, and children lost their lives in automobile accidents in the United States, and ten times as many were injured. Contests for right-of-way at crossings, speeding, driving on the wrong side, failure to give proper signals, and "cutting in," in the order named, caused that alarming casualty list. Motorists are being driven to insurance for protection, and more than fifty percent now have automobile "coverage" in one form or another.

BUT automobile insurance does not cover every kind of accident nor protect the policy holder in any and all circumstances. Before he goes spinning blithely over the highways the motorist should know about the "exclusion clauses" in his policy—little "ifs," "ands," and "buts" that may some time cost him dear.

Remember this: Report to your insurance company every accident that may happen to you, regardless of whether damage is done. Make the report in writing and immediately. Failure to do so may render your policy void.

A business man, "hitting it up" to keep

an early appointment, collided with another car. He left his damaged machine at the scene and took a taxicab. Hours later he remembered to telephone his insurance company. The company was "awfully sorry, but—!" He had not made a prompt report and he had left his car unguarded for hours, without waiting for the garage man or the insurance adjuster to arrive. Either omission, he learned, was sufficient to nullify the policy.

The theft-insured motorist who expects a new car if somebody "steals the old bus" should remember that the insurance companies limit their liability to "not to exceed the actual cash value of the automobile at the time of the theft." Also they specify that they "shall have the right to return a stolen automobile or its equipment, with compensation for physical damages, at any time before actual payment is made."

AND, in addition, theft policies do not, by any means, cover theft in any and all circumstances.

A little middle western storekeeper's clerk ran off with his employer's car.

"I'm afraid you're out of luck all around," the insurance investigator told the owner. "You should have reported the theft immediately."

"But I didn't think he had stolen the car," the storekeeper explained. "I wanted to give him a day or two leeway before I turned him in as a thief."

"We might let that part pass," replied the investigator. "But under 'Section G, Definition of Perils,' the company specifies that it shall not be legally liable to pay your claim."

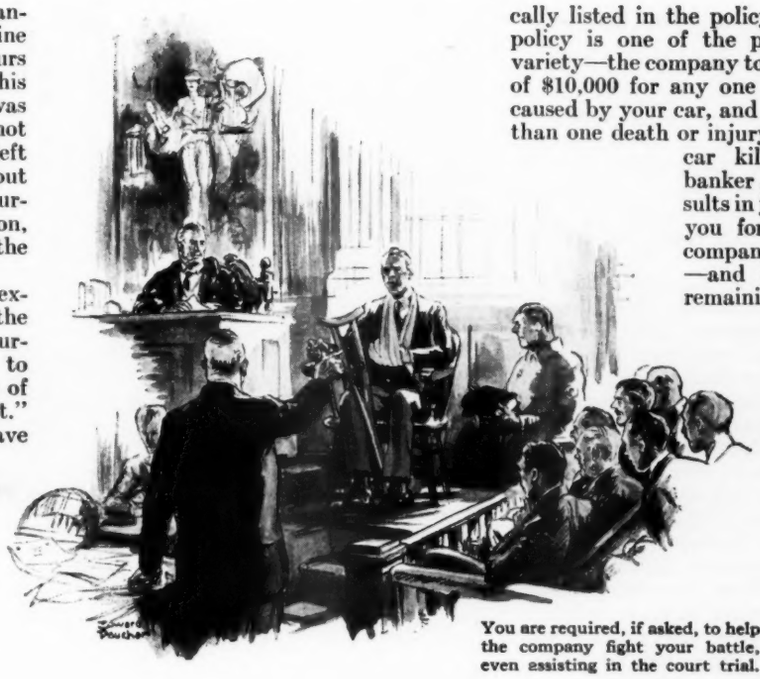
The section indicated said the company would pay claims for theft, robbery, and pilferage.

"*Excepting* by any person or persons in the assured's household or in the assured's service or employment, whether the theft, robbery, or pilferage occurs during the hours of such service or not."

And the "exclusion clause" had still another kick in it:

" . . . and *excepting* loss suffered by the assured from voluntarily parting with title and/or possession, whether or not induced so to do by any fraudulent scheme, trick, device, or false pretense or otherwise."

In the matter of personal liability insurance, the insurance companies only pay not to exceed the amount of damages specifically listed in the policy. Suppose your policy is one of the popular "10–20" variety—the company to pay a maximum of $10,000 for any one death or injury caused by your car, and $20,000 for more than one death or injury. Suppose your car kills a prominent banker and a lawsuit results in judgment against you for $30,000. The company will pay $10,000—and no more. The remaining $20,000 must be made up by you.



You are required, if asked, to help the company fight your battle, even assisting in the court trial.

A FRIEND of the writer was driving home in the rain one night when a pedestrian, his vision obscured by an umbrella, stepped into the side of the machine. The man wasn't even knocked off his feet, but the motorist stopped and, while the crowd looked on, promised he would "fix everything up all right."

He didn't report the incident to his insurance company—it didn't seem "worth making a fuss about." But before the month was out the pedestrian had sued him for $5,000, declaring a nervous disorder had been induced by "the shock and shaking up."

My friend's insurance company disclaimed liability because he failed to report the incident immediately and because he had apologized and seemingly accepted blame.

BE CAREFUL about assuming blame or offering to "fix things up." The policy does not prohibit you from arranging and paying for first aid treatment or "immediate surgical relief," but it does specify that your voluntary contributions shall stop at that point unless you are prepared yourself to stand the entire expense. In the words of the insurance contract, the motorist "shall not voluntarily make any payment, assume any obligation, or incur any expense," except for the emergency surgical relief noted.

Even after you have made the proper reports and complied with all the rules and regulations, you are required to help the insurance company fight your battle if it asks you to. If requested you must assist in preparing evidence and rounding up witnesses.

Your automobile collides with another machine. If you have property damage insurance, the (*Continued on page 143*)

A BUSINESS man would not think of signing an important business contract without first examining carefully every word in the agreement. Yet many a man thinks his automobile insurance policies, which he has no more than glanced at, will "cover" him, whatever happens.

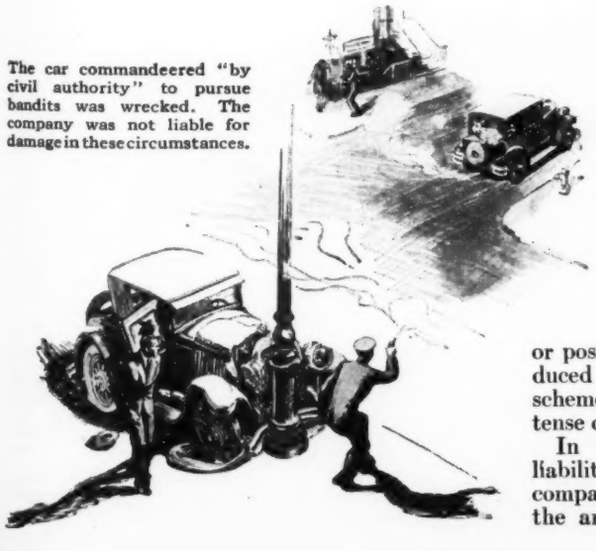
Through this negligence more than one motorist has burdened himself with debt for years to come.

Reputable insurance companies do not slip "jokers" into policies to defraud their policy holders. But their contracts do legally place upon the automobile owner definite obligations. It is up to you to know exactly what those obligations are.

When you have read Mr. Helm's extremely valuable article, you will know exactly why you must READ YOUR POLICY.

You owe that precaution to yourself and your family.

The motorist should read carefully each word of his policy; then he will know what he is protected against and will know against what he has no protection.



The car commandeered "by civil authority" to pursue bandits was wrecked. The company was not liable for damage in these circumstances.

New U.S. Submarine, Largest in World, Is Also the Safest

THE *V-4*, largest submarine in the world and latest to be commissioned for service in the U. S. Navy, will not lack for safety devices. Its great size permits many that would have overburdened smaller craft, the Navy announces, and the giant boasts 106 provisions for the safety of its crew.

Among the most important features are three separate escape hatches, instead of one as formerly. By their use a trapped crew could crawl out through the ship's side in fairly shallow water. Older submarines had one hatch in the conning tower, forcing a person escaping upward to face a downrush of sea water. The ill-fated *S-4's* conning tower was smashed, making even this impossible.

Independent air lines for each compartment make it possible to pump air to men within the new undersea craft no matter where they are. There is an independent supply of fresh water in each compartment, so that it can serve even if the rest are cut off. All hatches can be opened from inside or outside—thus rescuers can enter if the crew is helpless.

Motorcycle Carries 5 Police

A FIVE-PASSENGER motorcycle that can outdistance a motor car is the latest addition to the Berlin police department. The German invention carries besides its crew a powerful searchlight, emergency rescue apparatus, and a spare tire. Three officers sit in a novel two-wheeled side car, and a fourth rides on a tandem seat behind the driver.

Baffling Mysteries of Mining

HOW did radium, most costly mineral in the world, and vanadium, valuable ingredient of modern alloy steel, happen to become concentrated in the sandstone rocks of southwestern states? Under what temperatures and pressures is gold deposited in quartz? To answer such questions, Dr. Waldemar Lindgren, chairman of the National Research Council's Division of Geology, urges that the mining industry establish a laboratory of the first order, at a cost that would be a small fraction of the industry's annual $1,400,000,000 revenue.

The research would lead to the discovery of new deposits and the better exploration of known ones, Dr. Lindgren avers; our knowledge of how ores came into being and where to look for them is all too fragmentary. Other questions he would like to have answered are how fissure veins are filled with minerals; whether there are lead and zinc buried deep in the Mississippi valley as well as near the surface; and how metals separate from molten rock to be deposited in adjoining rocks.

New Use Found for Cadmium

NOW a new use has been found for cadmium, brother metal to zinc and, combined with other chemicals, the chief ingredient of brilliant yellow paints with which we are familiar. It has recently been utilized in the making of special new solders that fuse at unusually low temperatures. Ordinary solders—such as are used to seal tin cans—contain lead, tin, and zinc; but when cans have colored lithographed labels intense heat discolors them and hence a low-melting solder is required. Cadmium has been found to be a useful component of such a solder, Carl E. Swartz, Selby, Calif., metallurgist, recently told the American Institute of Mining and Metallurgical Engineers.

New Perfume in Paste Form

SOLID perfumes to replace liquid scents have appeared in this country following their recent introduction in Paris. Intended for travelers in particular, they are in paste form and are applied to hair, neck, or clothing. Ordinarily paste obtained by boiling flowers in fat is distilled to make perfume, but the new scents are simply the undistilled paste.

Phone on Aerial Fire Engine

FIRE engines are keeping pace with the mechanical progress of this fast-moving world, as the remarkable photograph at the right shows. The latest engine, recently demonstrated in London, is a combination pump, fire escape, monitor, and searchlight, with amplified telephonic communication with the ground. The fireman at the top of the 85-foot escape can telephone to comrades below.

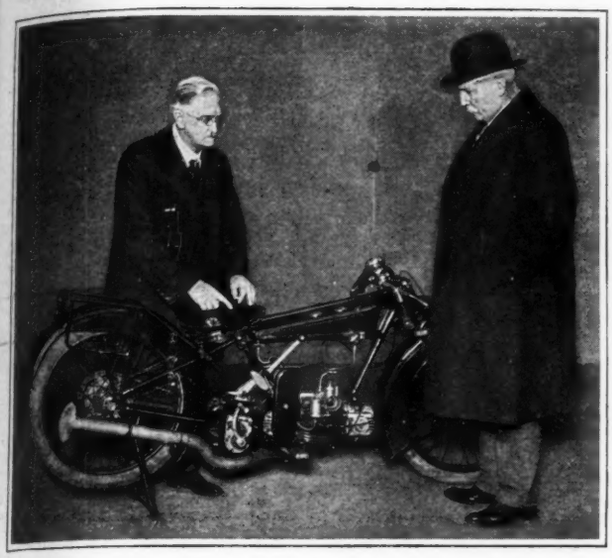
Truck Driven from Outside

HOUSE to house delivery is expedited by a new truck which the driver may operate from the running board as well as from the driver's seat, says a Virginia dairy company that has installed it. The truck, its makers say, is so noiseless that it won't wake sleeping customers.

Clock Can Be Seen 20 Miles

AT A distance of twenty miles or more, when the weather is fair, you can tell the time by a remarkable new electric clock that has recently been installed in Baltimore. It faithfully indicates the hour by red and white flashes from sixteen huge electric lamps.

A fireman 85 feet in air on the remarkable new English aerial pump and rescue tower, saving a smoke victim and telephoning to his chief on the ground.

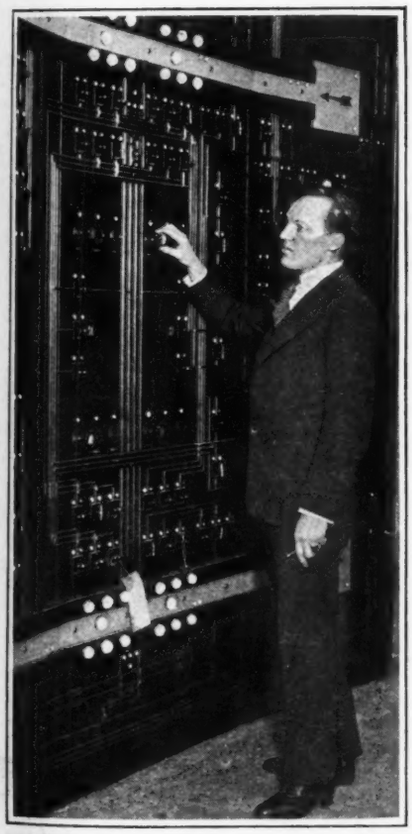


New Engine Slashes Gas Bill

MORE than twice the power of an ordinary engine with less than half the fuel consumption is the claim made for a new type of motorcycle engine introduced by an Australian inventor. The engine develops twelve horsepower, and in a demonstration before the High Commissioner of Australia, shown above with the inventor, is reported to have made close to 14,200 revolutions a minute.

20 Billion Ice Cream Cones

ENOUGH ice cream to make twenty billion ice cream cones is America's consumption each year, a recent estimate states. In twelve months' time, we eat 324,000,000 gallons, according to figures placed before the International Association of Ice Cream Manufacturers at Atlantic City, N. J.



George T. Riley, operating executive, controlling traffic in tubes under the Hudson and keeping the air free from deadly gas, all by throwing switches.

Autos Lead in Use of Power

NEARLY seven hundred million horsepower—enough, if converted into man-power, to furnish every man, woman, and child in the United States with sixty servants—is the total capacity of all the power generating equipment installed in this country, according to the latest exact figures, for 1923, just released by the U. S. Department of the Interior. This estimate includes every kind of power-producing device from the largest steam turbine to the erratic windmill and the farm work animal.

An astonishing fact is that passenger automobiles make up the major part of this total. Their combined power has been found to be nearly twice that of all the machines used in industry.

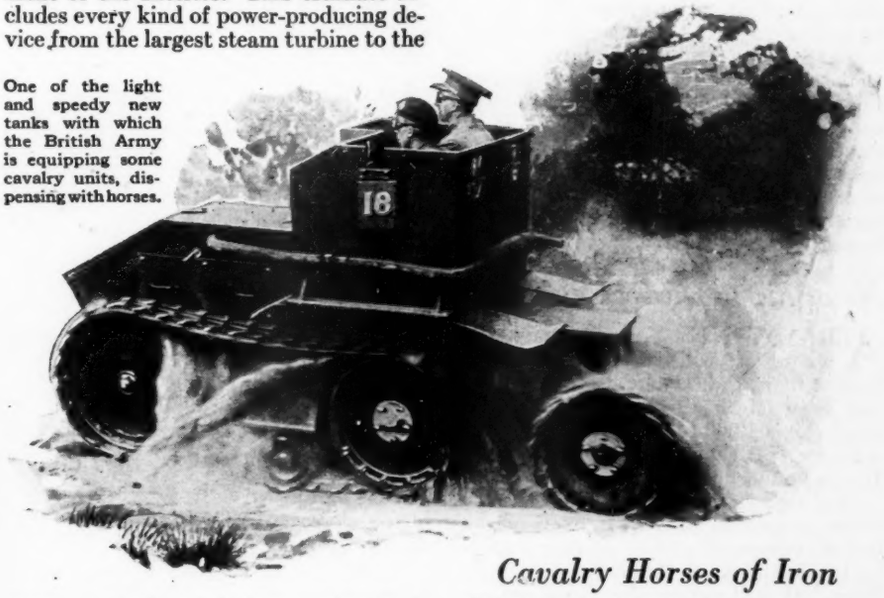
One Man Rules Tunnel Traffic

ONE man standing before two huge control boards, one of which is seen at the left, supervises the operation of thousands of automobiles that pass daily through the twin tubes of the Holland vehicular tunnel under the Hudson River between New York City and Jersey City, N. J. Red, yellow, and green lights, flashing on the boards, signal the location of traffic tie-ups or accidents, and the operator summons emergency trucks or diverts the flow of traffic by throwing designated switches. Recorders show by graph the amount of carbon monoxide gas in the atmosphere in the tubes. When buzzers indicate the sections in which there are more than two parts of gas to 10,000 parts of air, the operator pulls a switch to set great supplementary exhaust fans whirring to clear the air.

Gigantic English-Made Bell Coming to American Church

A FEW weeks ago the largest assembly of bell-ringers England has ever seen gathered at Croydon to hear the booming of the biggest bell ever forged in that country—a giant that will be shipped to America to find its home in the tower of a New York City church.

Though it is half as heavy as the famous bell Big Ben in the Westminster Clock Tower, London, it is not the world's biggest; there are numerous claimants for that honor. Moscow has a great dome-shaped affair that was long used as a chapel; also a huge forging called the largest bell that is still a bell. An eighty-ton bell swings in a Burma pagoda, and Pekin, China, boasts one of fifty-three tons. Nanking, China, and Vienna, Austria, have giants, too; and Great Peter at Yorkminster, England, and the bell of Notre Dame Cathedral in Paris are famous for their size.



One of the light and speedy new tanks with which the British Army is equipping some cavalry units, dispensing with horses.

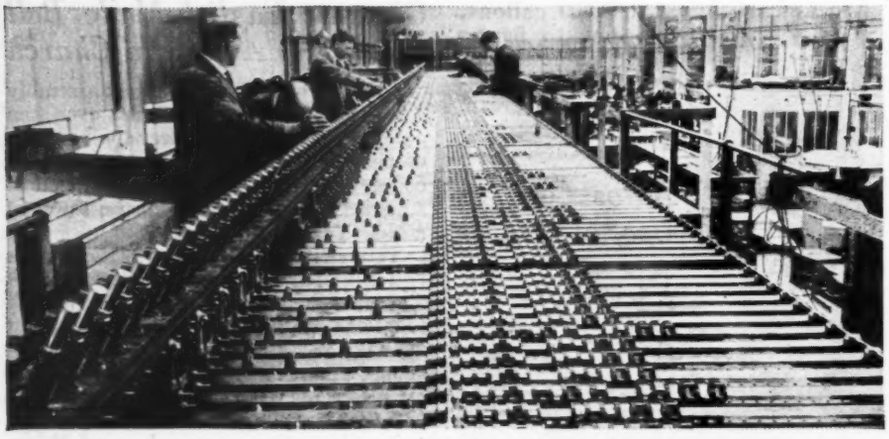
Cavalry Horses of Iron

CAVALRY charges of the future may be thunderous and clanking assaults of platoons of mechanical steeds, as the armies of the world continue to perfect new types of caterpillar tanks for modern warfare. The British Army has begun eliminating horses by equipping cavalry units with baby tanks, and recent tests proved their worth. The tanks have open tops, in contrast with the closed compartments of the World War types.

Tries to Rent Air to Planes

A NEW idea in money-making—the collection of rent from airplanes passing overhead—recently occurred to Samuel Schwarz, owner of a house at Zehden, Germany, who interpreted literally an old law reading, "The rights of a property owner extend to the space above and the ground beneath his property." He wrote to the Lufthansa, the German commercial flying organization, demanding a settlement.

Unfortunately for his ingenious plan, the Lufthansa cited the German air traffic law entitling aircraft to free passage so long as they observed the law.



Westinghouse engineers at Chippenham assembling the gigantic signal control box of the Southern Railway that will direct 2,000 trains a day. The signal system, which is being set up at London Bridge, reaches all trains with its electric "nerves." It is called the largest single system ever built.

Box Controls 2,000 Trains

TWO thousand trains a day whiz along the Southern Railway's tracks in England. This entire stream of traffic is to be controlled by a tremendous signal box at London Bridge. Miniature levers that operate the intricate signal system border the control box as far as the eye can see. Its "nerves" are a maze of electric cables. From this single box, operators can direct every train speeding over the complicated network of railway tracks; or, at will, they could paralyze instantly the entire line.

New Ship to Dwarf Leviathan

ALREADY New York is wondering where it will dock the world's biggest liner, the *Oceanic*, whose keel has just been laid at Belfast, Ireland. The great ship's 1,000-foot length will require a longer pier than any yet in existence. It will be finished by 1932.

If it were stood on end, the vessel when completed would far overtop the tallest skyscraper, and would reach exactly to the peak of the Eiffel Tower in Paris. It will dwarf the *Leviathan* by ninety-three feet, and the *Majestic*, longest liner afloat, by eighty-five. The sixty-thousand-ton ship will cost thirty million dollars.

Figures Deny "Race Suicide"

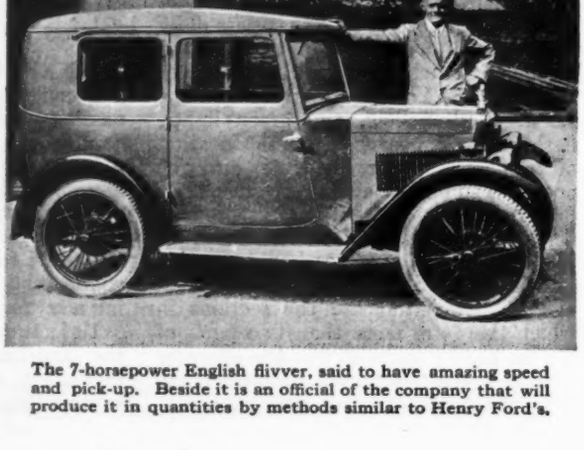
AMONG things to worry about comes the occasional warning, on one hand, of the danger of "race suicide"; on the other, of the peril of an overpopulated earth with not enough food to go around.

Which should cause the most concern? Results of the latest investigations seem to answer: "Neither."

A study of sterility, just reported to the National Academy of Sciences, shows that only seventeen percent of American marriages among white people are childless. Only thirteen percent are actually sterile, divorce or death accounting for the other four percent. Among every 100,000 white women, 78,207, more than three fourths, eventually marry. In a country of some 110,000,000 people, such figures are not held to indicate a lack of children to perpetuate the race.

Was Methuselah 969 Years Old?

DID Methuselah, of Biblical fame, really live to an age of 969 years—or was that the life of the clan he founded, that bore his name? The latter is the sensible interpretation, R. P. Field, of Philadelphia, recently told the American Philosophical Society. The chronicled birth, apparently of a son, to many a patriarch, Mr. Field declares, was not that of a person but of a new tribe that had split off from the father's clan. All dates of the Old Testament need revision, says Field, who places the time of Adam, for example, between 15,000 and 20,000 B. C.



The 7-horsepower English flivver, said to have amazing speed and pick-up. Beside it is an official of the company that will produce it in quantities by methods similar to Henry Ford's.

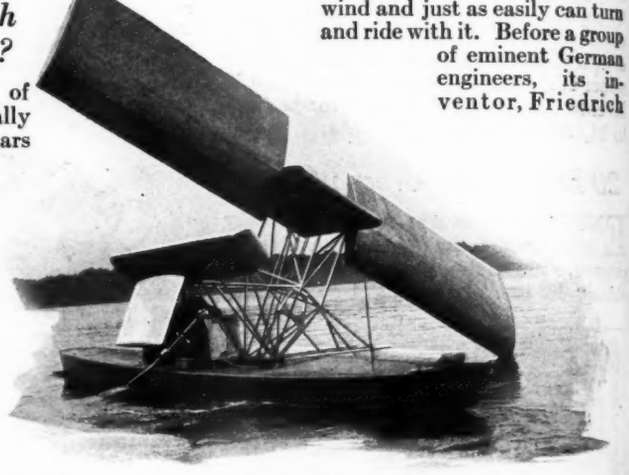
Giant Zeppelin for Sale; Will Go to Highest Bidder

DO YOU know of anyone who would like a nice, brand-new dirigible for Christmas? If you do, now is your golden opportunity. For the Zeppelin Construction Company of Germany announces that it will be only too glad to sell to the highest bidder the mighty airship *LZ-127*, now being rushed to completion. The reason is that a plan to use it for commercial voyages between Spain and the Argentine Republic fell through, for lack of adequate South American landing facilities, and left the huge craft without a buyer.

It is true that the ship would make a rather expensive, and a bulky, personal possession; it is 770 feet long, half again as large as the *Los Angeles*, America's one great airship, and carries one hundred passengers with ease.

Airplane Wings on Sailboat

LIKE an airplane in appearance is the novel sailboat seen below that can seesaw its way directly against the wind and just as easily can turn and ride with it. Before a group of eminent German engineers, its inventor, Friedrich Budig, of Berlin-Grunau, demonstrated how his queer craft could capture the wind's direct force to tilt the air vanes first to one side and then to the other, driving a propeller that pushes the boat forward. Pontoonlike keels that rock with the large planes strike the water and keep the craft from upsetting. The novel boat can be steered and turned around at will by the operator by altering the slope of the wing vanes.



The German sailboat with wings like an airplane's, which catch the wind from any direction and transfer its power to the propeller.

A 7-Horsepower English Car

NOW England, too, is to have its flivver, according to reports. Recent secret tests of a new automobile of only seven horsepower—only a third of that of most American small cars—are said to have shown it capable of amazing speed and pick-up. Gasoline economy is also claimed for the midget car, shown at the left with an official of the concern that expects to manufacture it by quantity production methods. Wide doors emphasize the unusual body lines of the sedan model, which is shown in the illustration at the left.

Novel Use for Typewriter in Making Flexible Rulers

IF A ruler marked in tenths of an inch is not available, when such dimensions must be measured, it may easily be contrived with a typewriter. Many typewriting machines make ten spaces to the inch; and a paper rule is obtained by typing a row of periods, alternated with commas every tenth space to mark inches. Such a rule can be bent around shafting and other round surfaces. Some typewriters use twelve characters to the inch, so one must determine which sort he is using. Often a ruler in twelfths is serviceable; in that case a machine with twelve characters to the inch is used.

Auto Launches Lifeboat

RIGHT down to the water's edge backs a new lifeboat-launching auto invented in Germany. Its body tilts, and as the boat slides into the water a curved guide points it upward to prevent its being swamped. With the speedy carrier, which holds the craft on steel rails, a boat may be launched in a fraction of the time it takes to drag it by muscle power down a beach, and with less effort.

This newest German life-saving automobile rushes to the beach and launches the lifeboat, which glides on steel rails into the water.

Asbestos Suits Worn in Fire

ASBESTOS suits are the latest style for firemen in Glendale, Calif., where the mayor and fire chief of the city recently gave them the hair-raising test seen at the right. Almost surrounded by flame in a small wooden shack deliberately set on fire, they fried an egg in the conflagration which nearly enveloped them. The suits saved them from injury, for the heat could not penetrate the thick mineral fiber.

Greater Power in Fire Boats

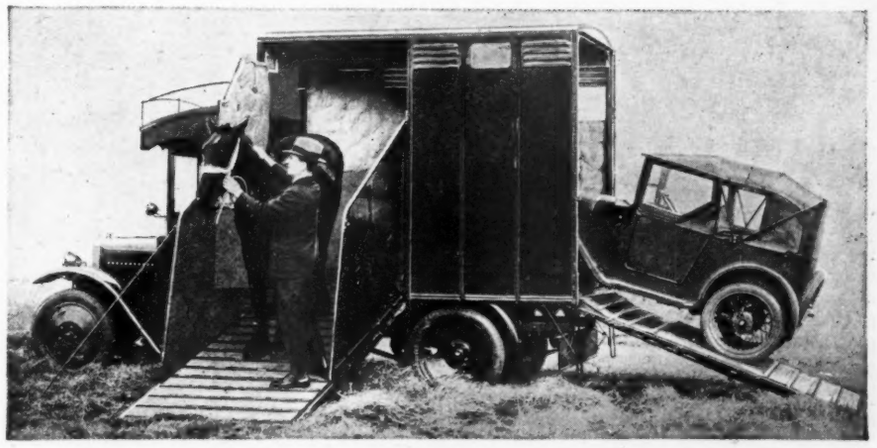
ADDITIONAL details concerning the speedy new fire boats put into service at Portland, Ore., and described in the June POPULAR SCIENCE MONTHLY, have been supplied by A. D. Merrill, naval architect who designed the boats. The operating mechanism of each boat, including pumping units, propelling units and generators, can be controlled by one man from the pilot house.

In stating that three of the boats can concentrate 9,000 gallons of water a minute on a waterfront fire, the report was in error, Merrill says. Instead, each boat has a rated capacity of 9,680 gallons a minute at 200 pounds pressure. Each is driven by two 565-horsepower gasoline engines, not Diesel engines as reported.

Dressing Ivory in Silver Coat

IVORY is given a silverlike finish that actually is composed of tiny silver grains by placing it in a dilute silver nitrate solution, and then in a solution of common salt until it turns deep yellow. Next the ivory is dipped in water, and exposed in the sun until it blackens. On rubbing, the black surface changes to a brilliant silver.

The mayor and the fire chief of Glendale, Calif., prove the value of new asbestos firemen's suits by frying an egg in a shack that is being consumed by the flames.



A hunting innovation in England. A motor van carries the horses to the starting point of the meet. The huntsmen arrive by auto, which occupies the van while the hunt is on. The sport ended, the horses are returned to the van, which has followed the chase, and the sportsmen motor home.

Automobile Van Aids Hunt

SERVING alternately as a portable double stall for huntsmen's horses and a conveyance for their touring car, an ingeniously adapted automobile van makes hunting more comfortable for English sportsmen. The horses are brought to the meet by van, while the men go by car. As soon as the horses are brought out, the car is loaded into the van by a block tackle, and its groom-chauffeur follows the hounds as far as possible while the hunt is on. When the day's hunting is over, the sportsmen return on horseback to the van, leave the horses in the groom's care, back out their motor car, and drive home comfortably.

Parachute Lands Airplane

THAT a huge parachute can land an entire airplane safely in case of motor failure was demonstrated again the other day at Tracy, Calif., in the latest of two years' experiments described from time to time in POPULAR SCIENCE MONTHLY. At an altitude of 2,200 feet, pilot E. J. McKeon shut off his plane's motor and went into a dive. The seventy-two-foot chute opened and checked the fall so that the landing was gentle. An unexpected complication occurred, however, when the plane, after landing, was dragged on the ground by its own parachute and somewhat damaged, indicating the need of some mechanism to release the plane from the parachute after the latter has served its purpose.

New Radio "Roof?"

AN ENGLISH physicist says he has discovered the existence of a second "radio roof." Fifty or sixty miles above the earth's surface experts believe there is a layer of electrified atoms of air gases underneath which the radio waves travel great distances, and through which they cannot penetrate. The new suggestion is that sometimes this "roof" dissolves and the waves reach a second layer possibly 150 or 200 miles high.

Model Tests Flood Control

TO DEMONSTRATE his plan for flood control, Carroll Livingston Riker, mechanical engineer, built this remarkable sixty-five-foot model of the Mississippi Valley and installed it in the basement of the Capitol at Washington, D. C. Rivers, valleys, and levees are shown in perspective. Running water tests in miniature the giant system of spillways by which Riker would divert flood waters into harmless channels and drain them off to the sea.

Blows Icebergs to Bits

FROM time to time, POPULAR SCIENCE MONTHLY has told of the experiments of Howard T. Barnes, Professor of Physics in McGill University, Montreal, in breaking up ice jams by the use of thermit, the remarkable mixture of iron rust and powdered aluminum which, when ignited, produces terrific heat.

Now Professor Barnes, in a report to the Engineering Foundation, declares that the same process can be used effectively to destroy huge icebergs which menace North Atlantic shipping. Thermit, when properly ignited, produces a white-hot liquid steel at temperatures as high as 5,000 degrees F. Its action converts ice into gases so rapidly that an explosion results. In this way an iceberg can be split into small pieces.

Weed Mower for Railroads

HUGE sums that railroads pay to destroy weeds along their right-of-ways may now be avoided by the invention of a new mower on wheels, towed by a motor handcar. Pivoted cutter bars cut a six-foot swath on each side of the track while the car rolls along at the dogtrot pace of four miles an hour. A wider swath can be cut on a return trip.

Should the cutters strike an obstruction, the mower automatically uncouples from its towing car and stops without damage. Since the cutters may be swung up or down by the operator, the device is said to be equally effective on level prairies and on the steep sides of banks.

The automatically tuned radio receiver. The set of control buttons, each of which instantly brings in a certain broadcasting station, is seen in the right side of the cabinet at the bottom.

Tells How to Remember Names and Faces

WHAT was your most embarrassing moment? Wasn't it the time you started to introduce a friend to a man you had met a moment before—only to discover that you had forgotten the latter's name?

Dr. Donald A. Laird, psychologist of Colgate University, has been studying ways to avoid this predicament. And he has worked out a series of mental exercises for remembering names and faces. Here are some of them:

Every evening sit down and recall the names and faces of all persons you have met during the day.

In periods of five minutes, practice repeating as many names of acquaintances as you can recall.

Practice recalling the names of characters in books you have read.

Ask a friend to call out the names of persons, and see how quickly you can respond with a description of each person.

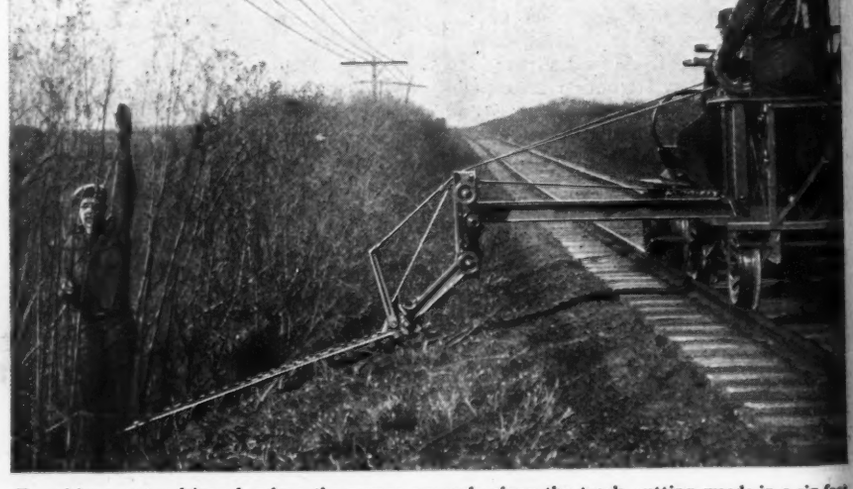
Whenever you are introduced to a stranger, make the practice of associating the meaning of his name with some object—as Mr. Pitt with pits. Or associate the name with some circumstance or character— as Mr. Scott, the automobile salesman, with the story of the Scotch automobilist who took so much free air that he blew out a tire.

Remember a name by the arrangement of its letters; for instance, the three e's in Greene.

Press Button to Tune-In

IT ISN'T any trick at all to tune-in your favorite broadcasting station with the new receiving set pictured at the left. All you need do is press a button; automatically the dials leap to the correct positions and in comes music.

Previously the receiver has been tuned to the station in the ordinary way and an adjustment tightened. Thereafter the station may be recalled at any time merely by touching the automatic control for that particular station.



Towed by a motor-driven handcar, the mower proceeds along the track, cutting weeds in a six-foot swath on each side. The angle of the cutting arms is adjusted by the operator to the slope of the bank.

Mouse Traps Camouflaged as Corncobs and Cans

CAMOUFLAGE—which helped win the war—is helping catch mice, according to a recent report of the United States Biological Survey at Washington. The latest traps are designed to deceive the most wary rodent. One, built for mice that rob corncribs, looks like a hollowed-out corncob and has its death-dealing spring hidden in the center. In another, designed to fool mice that chew papers in your desk at night, the spring is shaped like a harmless paper-clip.

An old tin can with its top partly mashed in is another. But when the inquisitive mouse jumps inside, he finds that the top springs shut with surprising quickness, leaving him locked within.

Still another is a trap that catches mice all night, automatically resetting itself. A metal door drops shut on the heels of the investigating mouse and in seeking a way out the prisoner follows a passage that suddenly shoots him into a half-gallon can filled with water. The mechanism is so constructed that the plunge of each victim resets the trap for the next mouse.

Making Phone Speak Up

A LOUDSPEAKER for your telephone now is available in the form of the portable amplifying unit pictured at the right. It is readily attached to any type of instrument. Although originally intended to make telephone conversations easier for persons with defective hearing, it is also useful in a noisy office where listening is difficult.

For the loud-speaking earpiece which is provided, a horn type of speaker may be substituted if privacy is not desired, leaving both hands free to take notes and handle papers.

The amplifying unit includes a special audio transformer with standard radio tubes and batteries. The volume of sound is regulated by turning a knob control.

Using the loud-speaking telephone. The amplifying unit, which uses radio tubes and batteries, is in the cylindrical cabinet at right.

Kite Does 300 Loops

THREE hundred loops in six minutes and thirty seconds! A homemade kite flown by Gustav Wilkoski, a fifteen-year-old Minnesota boy, recently set this world's record in a contest at St. Paul.

Toys Teach Housebuilding

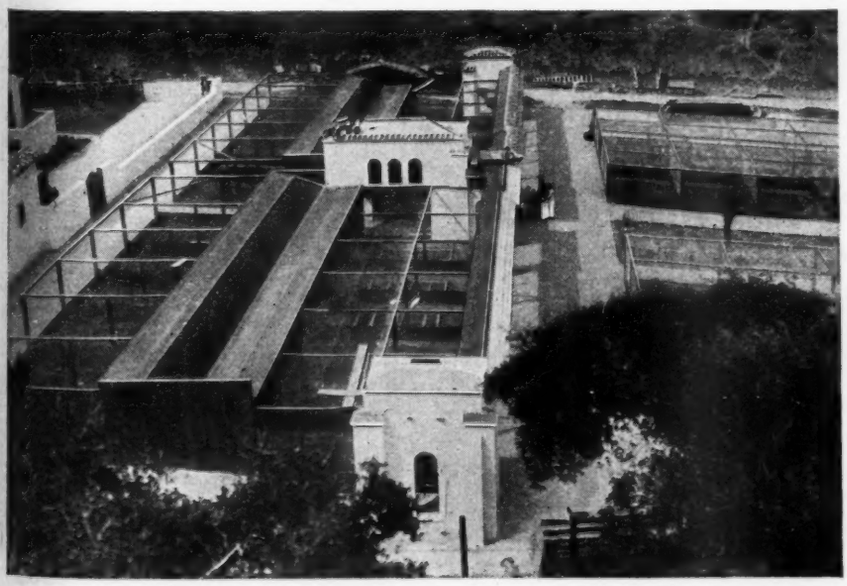
A TOY with a valuable educational purpose is a housebuilding set for youngsters that has recently been placed on the market by a member of the National Committee on Wood Utilization.

To the boy who plays with it, the set, with its tiny sills, beams, joists, and rafters, some of which must be cut to size, affords limitless fun in constructing lifelike dwellings in miniature. Its ultimate aim is to teach young America to distinguish between good home construction and bad. Then, according to the committee which sponsors the idea, they will be in a better position to escape the wiles of slipshod housebuilders and insist upon correct and efficient utilization of wood in their future homes.

World's Biggest Bird Cage

THOUSANDS of rare birds will occupy the world's largest aviary, nearing completion on Catalina Island, Calif. It is soon to be open for public exhibition and scientific research. Already live specimens from plains, mountains, and tropical jungles are arriving daily. All kinds of wild fowl will be propagated in the breeding pens.

The immense bird house is being built as a civic enterprise.



The gigantic bird house that is nearing completion at Catalina Island, California. Here thousands of rare and beautiful specimens of wild birds from all parts of the world will be housed and bred.

Sounds That Climb Highest

RECENT tests show that the crowing of a rooster, the ringing of a church bell, and, under some conditions, the shout of a man penetrate almost a mile into the upper air.

A cricket's chirp carries up 2,500 feet, and the croak of a frog can be heard at an altitude of 3,000 feet. Among sounds produced by living things, a dog's yelp holds the altitude record. It has been heard by balloonists 5,900 feet up. The report of a rifle will carry about the same distance.

Of all sounds recorded, a locomotive whistle reaches highest. It has been heard more than two miles above the earth.

Earthquake Telegraphs the News of a City's Doom

HOW an earthquake telegraphs a message of destruction far in advance of human communication is disclosed by official records of the quake that recently wrecked the city of Philippopolis, Bulgaria. At the instant the quake struck, seismographs all over the United States penned their record. From observatories where the instruments were housed, readings were telephoned to Washington, D. C., as fast as they could be deciphered.

Experts of the U. S. Coast and Geodetic Survey combined them and plotted off the apparent center of the disturbance on a map. Their lines crossed squarely upon the doomed city of Philippopolis. Three days later, over repaired Bulgarian telegraph lines, came word that Philippopolis had been wiped out.

Photos in Natural Colors

JUST arrived in the United States is Joseph Darbel, French inventor, seen above with his ingenious new camera to take pictures in natural colors. In reality it takes three pictures simultaneously, through a single lens. Each records one of the three primary colors from which all tints of a scene are blended. In order to do this, three separate film- or plate-holders are provided, and inside the camera's body is a set of mirrors and filters to separate the colors.

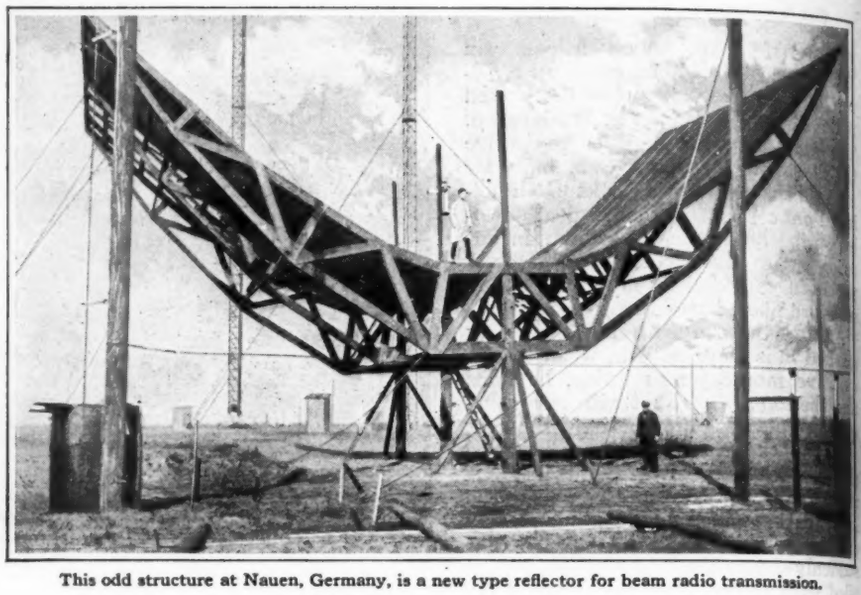
When the pictures are developed, a transparent print in its proper color is made of each. The three, combined, give a single photo in natural colors.

Colds Are the Costliest

COLDS and bronchitis are the most prevalent ailments in America. Influenza and grippe come second.

These statements come from Dr. Hugh S. Cumming, Surgeon General of the U. S. Public Health Service, after two years' investigation. Respiratory infections cause more lost time in industry than any other group of diseases.

Huge Reflector Sends Beams of Radio



This odd structure at Nauen, Germany, is a new type reflector for beam radio transmission.

SOMETHING new in "beam radio" is a remarkable reflector for radio waves being tried out at a Nauen, Germany, transmitting station, in experiments in "pointing" a radio beam at one particular receiving station. This method conserves power and makes secret communication possible without the necessity of a code.

In other beam radio stations, the reflector is a curved row of vertical wires behind the transmitting aerial; but the Nauen experimental station stretches the reflecting wires over a horizontal frame as shown above.

Puzzle in Auto Lights

REMARKABLE inconsistencies in auto lighting laws among various states are revealed in a chart recently compiled by engineers of the National Lamp Works, Cleveland, O., which is seeking a uniform lighting code.

The distance a car's headlights must be visible varies from seventy-five feet, in Delaware, to two hundred feet in seventeen other states. Though red tail lamps are the usual rule, you may use yellow in four states and green in Wyoming.

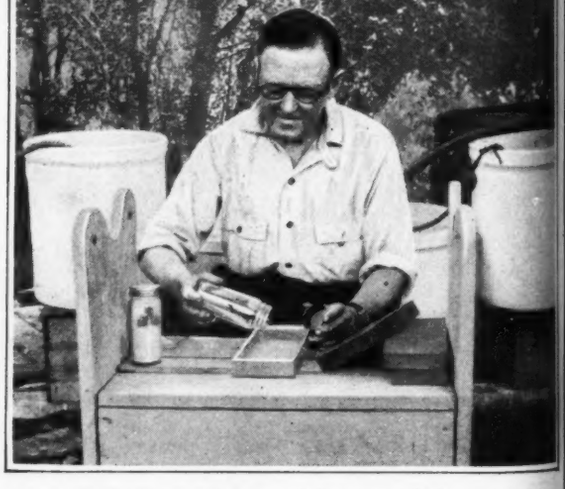
More Powerful Than TNT

ALTHOUGH his new explosive "radium-atomite" is many times more powerful than TNT or nitroglycerin, Capt. H. R. Zimmer, of Los Angeles, handles it as if it were so much flour. A former Army officer, he developed the remarkable invention in his outdoor laboratory. His new green powder, recently tested before military officials, contains radium. It is safe to mix, for it requires a spark to set it off.

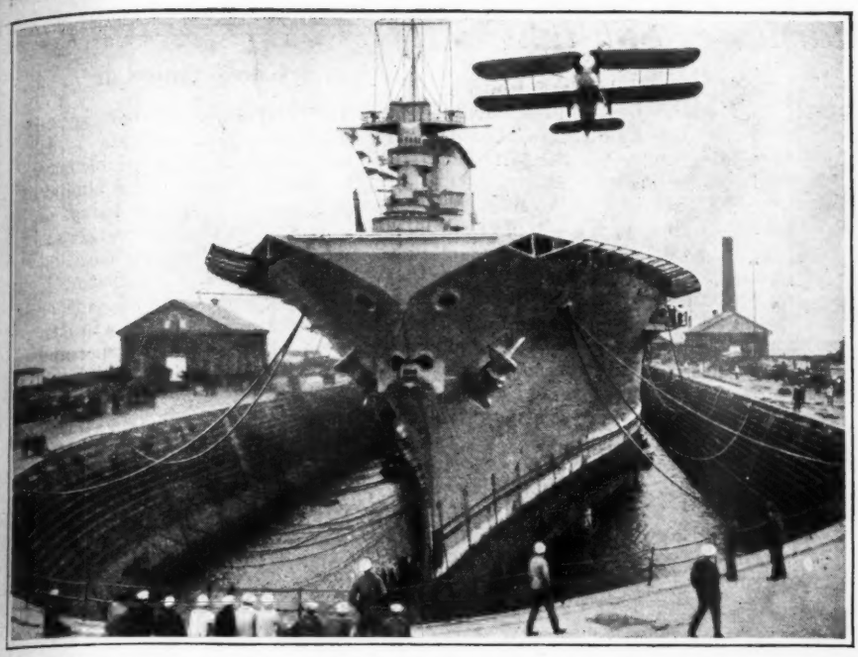
Hunt Mysterious Element

ONE of these days a new element may be added to our list of known ones, all but bringing it to completion. A mysterious, unidentified radioactive element, much more potent than uranium, radium's parent, exists on earth and releases quantities of energy, Prof. Walther Nernst, of the University of Berlin, recently told the Franklin Institute at Philadelphia. Another expert, Dr. Charles F. Brush, inventor of the arc light, declared his belief that recently-hardened steel, and also silicate of cobalt and other chemical compounds, contain it.

Chemists say there are ninety-two simple substances, or elements, of which all things are made. Ninety now are known, ranging from hydrogen, the lightest, to uranium, the heaviest. Two blank spaces in their list, for the unknown elements No. 85 and 87, fall in the group of radioactive substances with radium and its ray-producing cousins.



Capt. H. R. Zimmer, inventor of the new explosive, at work in his outdoor laboratory. His apparatus consists of a few crocks, a small bicycle tire pump, a syphon, and an ice cream freezer.



New Plane Carrier Sets Speed Record

ON HER recent voyage from San Pedro, Calif., to Honolulu, 2,228 nautical miles, the U. S. Navy's new aircraft carrier *Lexington* shattered all records, doing 700 miles the first twenty-four hours, 742 miles the second, and 786 miles in the remaining twenty-four hours and thirty-four minutes. The average speed was 30.7 knots an hour. Since then the craft, with defective turbine blading perfected, has made 33.04 knots. The light cruiser *Omaha* held the world's twenty-four-hour record, 690 miles, and the distance record—2,091 miles from San Francisco to Honolulu in seventy-five hours, forty minutes, and forty seconds.

Cancer Cost Near a Billion

LAST year cancer caused a loss of $800,000,000! That is approximately what 300,000 workmen would lose if they were out of jobs for a year.

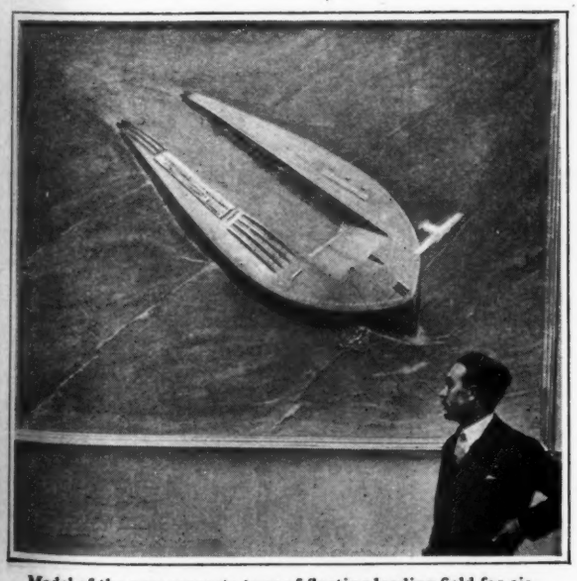
This estimate comes from Dr. Louis I. Dublin, statistician of the Metropolitan Life Insurance Company. And he predicts that the loss will be even greater for the present year. Cancer is steadily increasing, despite all efforts of science to stop it.

Of the total $800,000,000 loss, Dr. Dublin says, $680,000,000 represents the money value of persons who died from the disease. This is equal to one tenth of the value of all the iron and steel manufactured in the United States. The remaining $120,000,000 was the amount of money which was spent in caring for the victims.

Haven for Planes

FLOATING concrete islands capable of being navigated from place to place like ships, by means of their own propellers, are the latest French idea in ocean landing fields for planes. The novel "seaports," of which a model was recently exhibited by the Chamber of Commerce of France, would be seaworthy enough, it is claimed, to take up stations as halfway stops in transocean flights. Planes would land upon them for refueling and take off with the aid of catapults resembling those used at present for launching planes from warships.

The islands would have hangars and living quarters for permanent crews of mechanics, according to their inventor, Charles de Frasse; and two giant 2,500-horsepower motors would propel them to their location.



Model of the new concrete type of floating landing field for airplanes, designed by a French inventor. It is driven by propellers. Hangars for planes and crews' quarters are provided.

Inventor Makes Wheels Spin the Right Way in Movies

MAKING whirling automobile or carriage wheels look natural on the screen—a twenty-year puzzle of the movies—has just been solved. Because movie cameras could not keep pace with the rapid flashing of the spokes, wheels often appeared to revolve backward.

Now John Nickolaus, laboratory head of the Metro-Goldwyn-Mayer studios, has discovered that he can keep wheels spinning the right way by painting out groups of the spokes. He applied dark paint to four sets of two spokes each on a buggy wheel, painted in light color the intervening spokes, and successfully photographed the wheel at all speeds.

Free Shower of Perfumes

TO ADVERTISE his wares, a German merchant of perfumery and toilet waters sprays with perfume all passers-by free of charge, and even scents the air in front of his shop.

From the top window of his store a little hose, seen in the picture above, shoots forth a shower of the merchant's different brands of perfumery, and the window shopper can sniff the air and make his choice from the sample before he goes in to buy.

Many Frogs; Prices Drop

BULLFROG hunters in the marshes of Louisiana have been making such big catches of late that there are more frogs now than there are people who enjoy the delicacy of their fried hind quarters. As a result of this overproduction, the market price of the croakers recently dropped to a low level—about half the price of dressed chicken.

Louisiana supplies the rest of the world with some two million frogs a year.

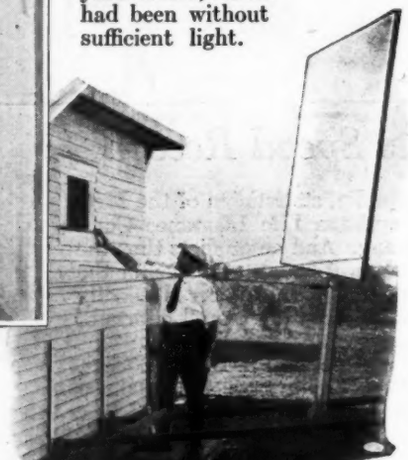
This Photographer Harnesses Sunlight

Above: Interior of the studio, showing ropes by which the operator adjusts the sunlight reflector, pictured at the right with its inventor.

SUNLIGHT reflected into his studio by a huge movable reflector is used by a California photographer in making enlargements.

The reflector, shown in the picture below, is made of aluminum-painted metal over a wooden frame. It is tilted to proper positions by ropes operated from the inside of the studio, and the rays are directed through a window, on the inside shelf of which the enlarging camera rests. The apparatus is mounted on a tracklike runway.

The inventor, Capt. Lee N. Passmore, of San Diego, rigged up the apparatus for his back yard studio, which had been without sufficient light.



No More Lost Golf Balls?

GOLF balls that figuratively call "Yoo hoo, here I am!" when they get lost in the "rough" are promised by a New York inventor. They depend on the player's senses of smell, hearing, and sight to help him discover them.

One plan is to coat the balls with the fireworks composition commonly called "spit devil." When the club strikes the ball the explosions begin. They continue for some time after the ball has come to rest, so that the golfer can hear the sputtering of his ball in the grass and so be guided to its hiding place.

Another suggestion is the application of a solution of phosphorus and carbon bisulphide. In the deep grass the ball would have a glow that would attract attention. Another method is the coating of the ball with a paste containing chemicals which when wet emit a gas. When a ball so coated falls into the grass, the moisture near the ground causes a chemical reaction and the vapor arises. This puff can be seen by a searching player. Various aromatic liquids may be used to soak the balls so when they get lost golfers can find them by walking along sniffing the air near the ball's supposed location.

What Is Your Question?

POPULAR SCIENCE MONTHLY is glad to answer, whenever possible, readers' questions on any subject within its field, and to supply names and addresses of makers of devices described in the magazine. A stamped and self-addressed envelope should be inclosed.

Uncle Sam Runs a Still

UNCLE SAM has turned to the bootlegger's equipment in experiments, under direction of the Prohibition Bureau, to develop a nonpoisonous denaturant for alcohol. The business of the Government's still, pictured at the right, is to do the same thing that the bootlegger does—take the poison out of denatured alcohol, but at the same time to make it disagreeable to the taste. The still is used in submitting prospective formulae for a harmless denaturant to severe tests.

How to Wheel a Barrow

SEVENTY bricks in a wheelbarrow, pushed at a brisk pace, are easier to wheel than fifty bricks in the same barrow trundled at a slow walk. The British Industrial Fatigue Research Board has come to this conclusion after tests.

Large rubber bags were attached to the backs of men wheeling varying weights at different speeds. The gases expelled from their lungs were collected and analyzed by chemists for carbon dioxide content. The result showed the amount of energy used during each test.

It was found that a slow walk required almost twelve percent more energy than a faster one, and that the least average expenditure of energy came from wheeling bricks at a brisk walk.

Know Your Car

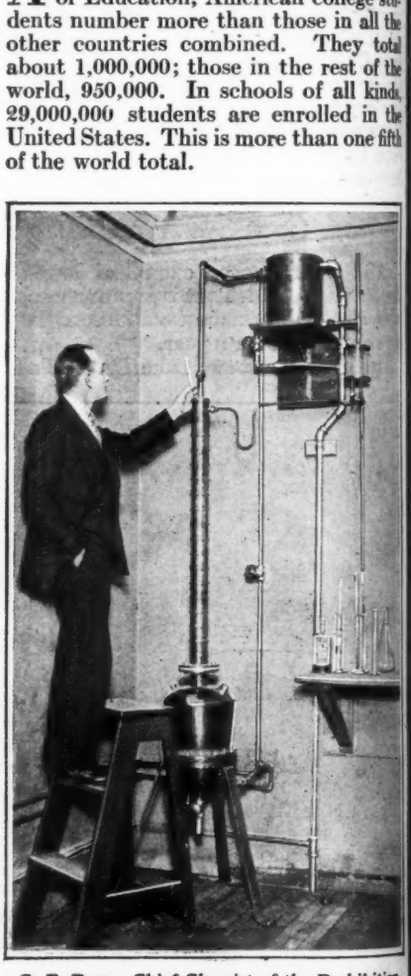
IF THE engine of your car unexpectedly overheats while you are driving, the trouble may be due to any one of a number of causes. The first thing, of course, is to make sure there is enough oil in the crank case and enough water in the radiator. If so, then look for a slipping or broken fan belt. Often a broken belt can be pulled together and tied with a stout cord, which will hold until you get to the next service station, where you can get a new belt.

Look next for a clogged water pipe or loose hose connection. You can tell whether the water pump is working by motion of water in the radiator.

A more serious trouble, and one which hardly can be remedied on the road, is a worn timing chain which, by slipping, may retard the spark and make the engine overheat. That is a job for the repair man.

29,000,000 Go to School

ACCORDING to the Federal Bureau of Education, American college students number more than those in all the other countries combined. They total about 1,000,000; those in the rest of the world, 950,000. In schools of all kinds, 29,000,000 students are enrolled in the United States. This is more than one fifth of the world total.



G. F. Beyer, Chief Chemist of the Prohibition Unit, at work with the Government still to concoct a nonpoisonous, bad-tasting alcohol.

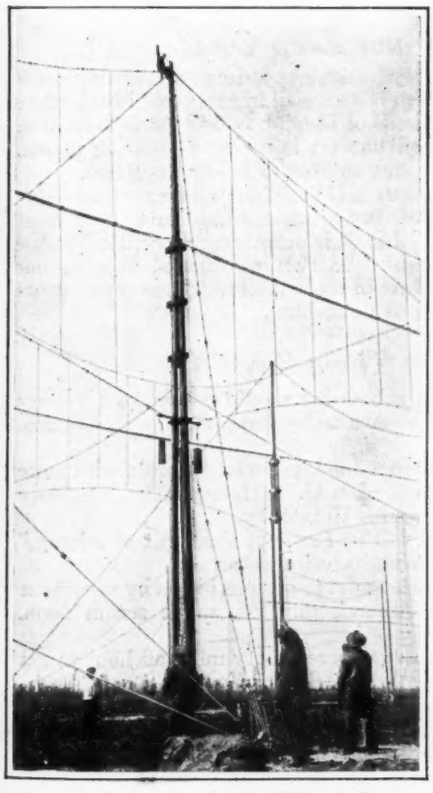
How Much Do You Know of the World You Live In?

TO TEST your knowledge, see how many of these questions you can answer. Correct answers are on page 136.

1. Where was the first oil well in the United States?
2. Where are the largest stones ever used?
3. Where is the Great Barrier Reef?
4. What people wear socks divided for the big toe?
5. Where do fish live in dried river beds?
6. Are there places where no plants will grow?
7. Where does asbestos come from?
8. What city is called "Paris of the East"?
9. What has cocoa to do with coconut?
10. What are the youngest mountains in the world?
11. Where do the "white Indians" live?
12. What is the oldest town in America?

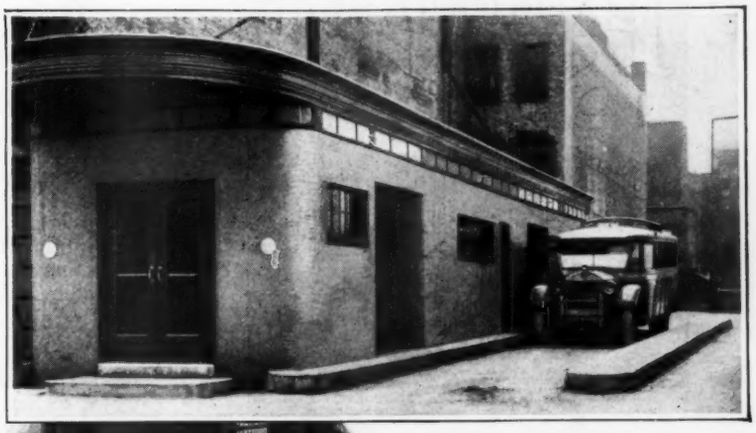
Room for Millions More

PROF. H. L. SHANTZ, of the University of Illinois, recently told the National Academy of Sciences that the earth is capable of supporting 8,000,000,000 people, if all the land is fully utilized. This would be nearly five times the present population of the world.



The new beam radio transmitting station at Rocky Point, N. Y., showing system of vertical wires that serves as reflector for radio waves.

Large Terminals Built for Bus Lines



TRAVEL by motor bus has reached such proportions in the East that fifty-four interurban lines now operate into New York City, and the bus companies are erecting terminals similar to railroad stations to accommodate the traffic.

These terminals are complete, with waiting rooms, restaurants, rest rooms, telephone and telegraph service, barber shops, and beauty shops. They are centrally located, the one shown above being in the rear of a leading New York theater.

At the left, a prospective passenger is seen in the new terminal reading a bulletin board showing the destination points of the bus lines.

But Not Exactly a Relish

THE Borgias and other notorious poisoners of history were reputed to have mixed finely powdered glass in food and drinks which they offered their victims. Recently, however, Dr. Roche Lynch demonstrated to the Medico-Legal Society of London that this supposedly murderous material usually passes through the human digestive system without causing death or even doing serious damage. Larger pieces of glass with sharp edges, however, are dangerous.

A Giant Radio Reflector

AT ROCKY POINT, N. Y., there has just been erected what is said to be the most efficient type of beam radio transmitter yet installed. Outstanding features are its simplicity and the efficiency with which it directs a pencil of radio waves toward distant receiving stations, resulting in economy of power and high-speed transmission.

From ordinary radio broadcasting stations, radio waves spread out in all directions, and most of the energy used up is wasted. The new system uses a system of auxiliary wires to serve as a reflector for the waves and focus them in a beam.

World's Largest Building

A BUILDING so big that the plumbing and wiring will be measured by "mileage" rather than by footage is being constructed in Boston. It will cost $21,000,000, cover 130,000 feet of ground space, and be the largest building in the world. It will surpass in floor area such famous structures as the General Motors Building in Detroit and the Graybar, Telephone, and Equitable Life buildings in New York. The construction will be completed within a year. The permanent population of the building will be nearly that of a city of 25,000.

Ten acres of the floor space will be occupied by a huge department store, which will be connected with a distant warehouse by an underground tunnel through which electric trucks will transport goods as needed in the store. Parcels for delivery will be sent to the warehouse, which will become the delivery center. The building also will be connected with the Boston subway system by a tunnel two blocks long.

Five stories above the department store will be reserved for a permanent exhibition of New England industrial products. Above this, offices will occupy the building to the top of the central tower, which a municipal height-regulating ordinance limits to 300 feet. There will be three basements. One will provide parking space for between 3,000 and 5,000 automobiles. The owners will drive in, leave their cars, and ascend in elevators to the store or offices above.

The huge structure will be known as the New England Building.

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The Kite String of Dreams

FIVE years ago, almost to the month, Rear-Admiral William A. Moffet, Chief of the Navy Bureau of Aeronautics, wrote a remarkable prophecy for POPULAR SCIENCE MONTHLY. He predicted giant air liners "of 5,000,000 cubic feet capacity, equal in size to the steamship *Leviathan*."

He saw "airplanes carried on them as are lifeboats on ocean-going vessels. These planes," he said, "could land on a deck on top of the airship and be launched from it, carrying passengers for wayside destinations. Imagination—but not too much of it" was his significant comment.

Today his vision is coming to pass. The Navy's two new giant dirigibles, each of 6,000,000 cubic feet capacity, will be built as aircraft carriers, almost exactly matching the description in POPULAR SCIENCE MONTHLY five years ago.

Writers for POPULAR SCIENCE MONTHLY are men of vision, never visionary. Every step in progress is born of imagination. The growth and influence of this magazine has been measured by a capacity to look beyond the horizon. But between idle dreaming and sound, practical imagination there is a vast difference.

A kite sailing in the clouds at the end of a long string. That represents imagination—the valuable kind. No matter how high it flies, it is still connected with the solid earth. As soon as imagination loses touch with fact it drops in value, as a kite flutters down the minute its string breaks.

We thrill at the glimpse of a future goal. We glory in visions come true. An inspiring rule for successful achievement are Moffett's own words: "Imagination—but not too much of it."

Hail to the "Coffee Johns!"

THE other day a hot-dog wagon took its place in the Ford Museum in Detroit beside the first Model T and the ten millionth car.

"Coffee John" used to own that wagon and Henry Ford used to eat there when he was a mechanic. Across its counter Ford outlined his plans for a "horseless carriage" to the sympathetic owner, and "Coffee John" lent the money that carried the struggling company over a crisis.

Delve into the history of almost any great company and you will find a "Coffee John" who boosted at the right time. Too frequently they are like Lawrance, the designer of Lindbergh's engine, who, when asked why he was so reticent, remarked. "Who ever heard of Paul Revere's horse?"

To the Ends of the Earth

WATER, dipped from the spot where Washington crossed the Delaware, christened Commander Byrd's monoplane. Had any of those drops swirled under Washington's boat?

Probably not. That water had flowed to the ends of the earth. Circulation of water, like circulation of the blood, carries away impurities. It keeps our planet healthful.

Circulation of a different sort is the great gift of science—circulation of people and ideas. And the speed with which people may be transported and ideas communicated is the greatest development of the Twentieth Century. To prove this, just recall that it took months for the news of the Peary Polar expedition to reach the public, while Nobile was in almost constant communication with the world. Millions followed on their radio sets the news of his rescue from the Arctic wastes.

Fame at the Doorstep

IT TOOK fifty centuries for the eye of a needle to move two inches, from the head to the point. Then Elias Howe's idea made possible the sewing machine and freed women from the drudgery in a task that dates back to the Bronze Age.

Starting with cave men who used splinters of bone, human beings had held needles in their hands day after day for thousands of years. Yet none had seen the revolutionary idea lying so close.

What idea, just as simple and just as important, will we overlook day after day in the year 1928? Perhaps there is a hint on page nineteen. Fame and fortune await the man who can find new uses for sulphur, or an economic substitute for tin.

Two Experiments

A TEN-YEAR-OLD boy at Camden, N. J., found a spike along the railroad. He put it on the track "to see if the big engine would flatten it out like it does a penny." The big engine didn't. A passenger train was wrecked, the fireman and engineer badly burned, and $250,000 worth of damage done.

The same day, officials of the Bureau of Standards made another experiment. They set fire to a condemned Washington, D. C., building, as told in this issue, after placing recording instruments on every floor. These instruments disclosed what happens within a burning building and the effect of the heat on office fixtures.

Experiments are worth while only when they contribute something to our store of vital, useful knowledge.

Why not Keep Cool?

AT THE University of Michigan experiments are being made with devices to keep houses cool in summer. Much effort has been spent on methods of keeping houses warm in winter. As a result, we have oil burners and central heating plants, hot water and steam—any number of heating systems.

Experiments with hundreds of individuals indicate that sixty-eight degrees Fahrenheit is the most comfortable and most healthful temperature. But it is surprising how little Yankee ingenuity has been applied to the problem of keeping our homes at that temperature in midsummer. Those experiments out at Ann Arbor are worth watching.

"Let Them Say!"

"I DO not see why a submarine should not make a voyage from Spitzbergen to Alaska."—Capt. George H. Wilkins, trans-Polar flyer.

"The porpoise, a stupid animal, has a larger brain with more convolutions than man."—Dr. O. R. Langworthy, Professor of Anatomy, Johns Hopkins University.

"Milk without cows will be the next short cut of science."—Alfred King, English sanitary inspector.

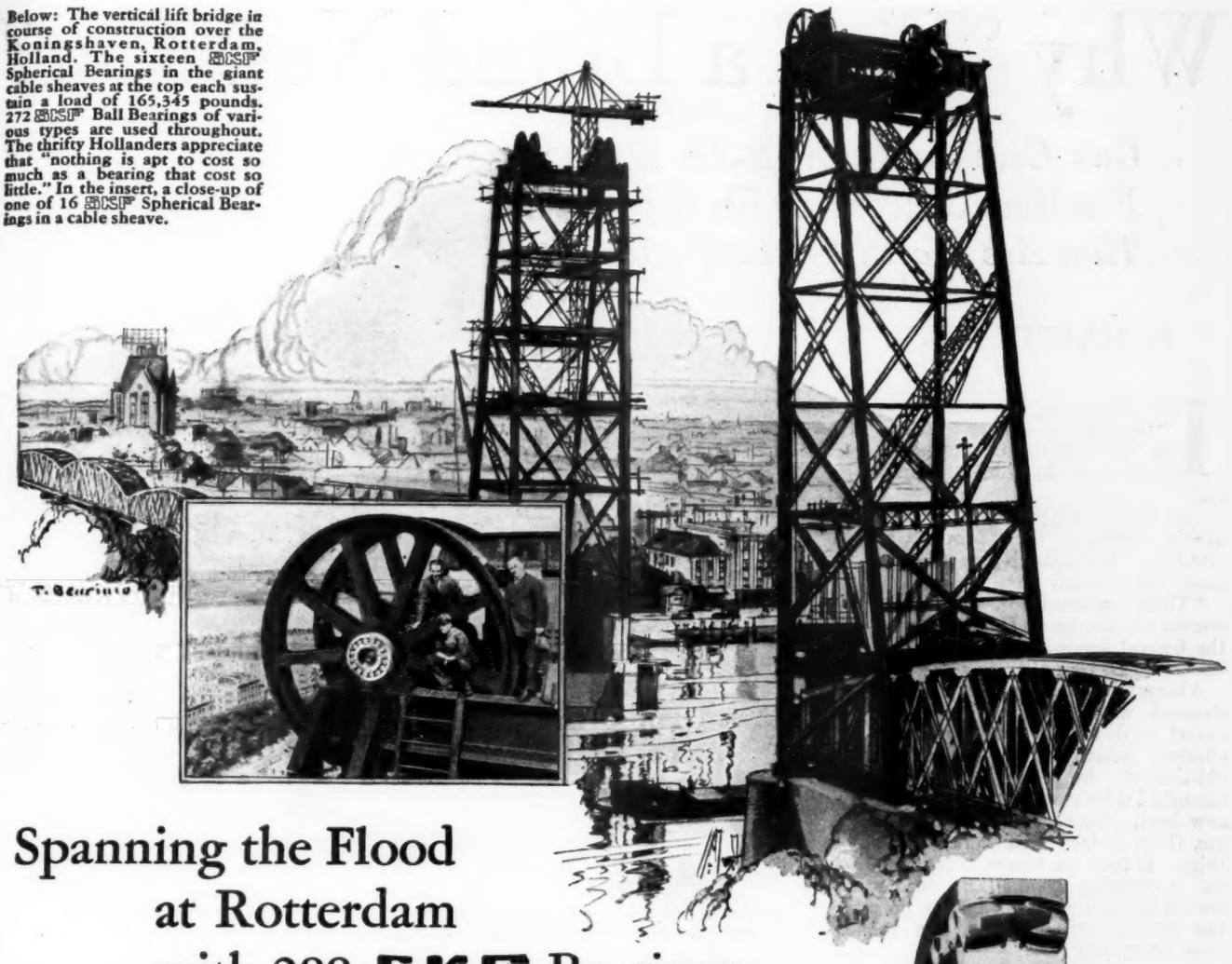
"Alcoholic liquors are harmful to persons bitten by venomous snakes."—Afranio do Amaral, director, snake serum farm, Butantan, Brazil.

"In time we won't have to race ninety miles an hour to get off the ground in an airplane."—Henry Ford.

"Four thousand planes will be built this year and twice as many could be sold if they were obtainable."—Clarence M. Young, Director of Aeronautics, U. S. Department of Commerce.

"What we need is an electric push button system so passengers can open car windows without a crowbar."—J. J. Tatum, Baltimore, to members of the American Railway Association.

Below: The vertical lift bridge in course of construction over the Koningshaven, Rotterdam, Holland. The sixteen SKF Spherical Bearings in the giant cable sheaves at the top each sustain a load of 165,345 pounds. 272 SKF Ball Bearings of various types are used throughout. The thrifty Hollanders appreciate that "nothing is apt to cost so much as a bearing that cost so little." In the insert, a close-up of one of 16 SKF Spherical Bearings in a cable sheave.



Spanning the Flood at Rotterdam with 288 SKF Bearings

IT'S a far, far cry from the new vertical lift bridge over the Koningshaven at Rotterdam, but there's a story behind it that echoes wherever anti-friction bearings are used—even on *this* side of the Atlantic.

For this great structure raises and lowers its lifting span with the help of 288 SKF Anti-Friction Bearings.

Sixteen SKF Spherical Bearings, the same that 45 American railroads use in passenger car journals, are in the giant sheaves atop the lifting towers.

Two hundred and seventy-two SKF Ball Bearings of various types—depending upon the service required of them—are distributed among the guide pulleys, the buffer sheaves, the guide rollers and other working parts.

For SKF, making practically *all* types of bearings, is *able* to put the right bearing in the right place *always*.

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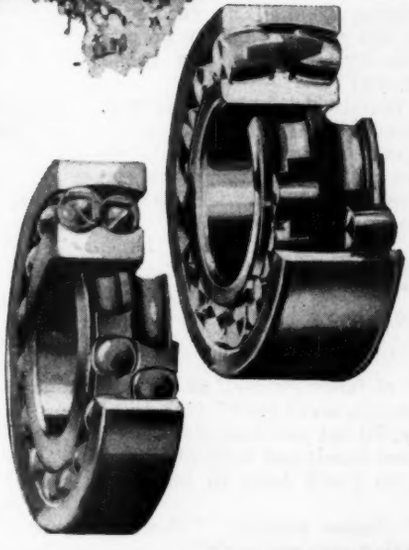

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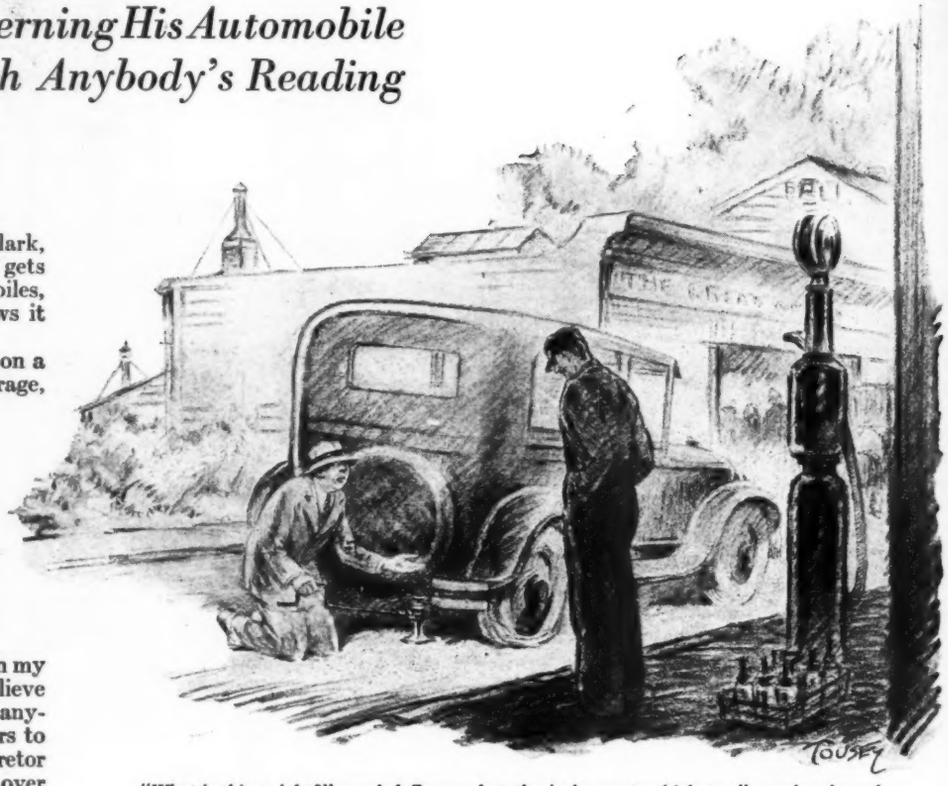
2059

Nothing is Apt to Cost so Much as a Bearing That Cost so Little

Why "Fix" a Brand-New Car?

Gus Gives a Know-It-All Driver a Few Hints Concerning His Automobile That Are Worth Anybody's Reading

By MARTIN BUNN



"What is this, a joke?" puzzled Green—but the jack was too high to slip under the axle and a look of dismay rapidly replaced the disgusted expression on the face of the know-it-all.

"ISN'T it funny," observed Joe Clark, "that just as soon as a fellow gets to know a little about automobiles, right away he thinks he knows it all!"

Gus Wilson, his partner, working on a motor outside of their Model Garage, grunted. "Know-it-alls give me a pain," he growled.

"Then," grinned Joe, "you're due for a severe pain. Here comes the biggest know-it-all in town, Archibald D. Green!"

A large and shiningly new sedan stopped with a crunching of gravel and a fat young man climbed jauntily out. "Hello, old-timers!" he called. "Just thought I'd let you feast your eyes on my new boat. Some class, eh? And believe me, those factory men don't know anything. It took me two or three hours to get it running good. The carburetor wasn't set just right. I had to go over the ignition system—even the brakes were set wrong!"

Green, thumbs hooked in his vest, strutted around like a pouter pigeon.

"It's a good looking bus, all right," observed Gus with a twinkle in his eye, "and I guess you can show 'em up when it comes to fixing an automobile."

"Surest thing you know," Green agreed, nearly snapping the buttons on his vest. "Nothing can happen to a car that I don't know how to fix and fix right."

"KIND of fancy yourself as an auto mechanic, don't you?" Gus growled. "Why, I'll bet you I can fix your car with my bare hands and without busting any part, so you'll have to holler for help."

"Huh!" Green snorted. "Here's a good cigar that says you can't!"

"All right," said Gus. "Just suppose you're out on a lonely road and a tire goes flat." He screwed the valve out of one of the rear tires and it collapsed.

"What the heck is this, a joke?" puzzled Green. "If you just wanted to see me change a tire, why didn't you say so in the first place?"

Disgustedly, he got out his jack and attempted to put it under the rear axle, but the top of the jack was at least an inch too high to slip under. The collapse of the big tire coupled with the small diameter of the wheel let the axle down too far. A look of dismay rapidly replaced Green's disgusted expression.

"You're sure some swell auto mechanic if you let a little thing like that stump you," grinned Gus derisively. "Hand me that cigar and I'll show you a few ways to raise your car.

"Now," said Gus as he clipped the end from the cigar Green handed him, "what's the matter with digging a hole for the base of the jack? And there's certainly nothing to stop you from placing the spare tire in front of the flat and driving the flat up on top of it. Then you can slip your jack under. If you haven't any spare along, you can run the car up on a piece of wood.

"And just a minute," called Gus as Green was about to climb into his car. "You said you had to adjust the brakes. What was the matter with 'em?"

"Nothing much," Green replied. "The car didn't seem to stop as quick as I thought it should with four-wheel brakes, so I just tightened 'em up."

"I thought so," grunted Gus. "See what happened when you stopped here." He pointed out where both wheels on one side had locked and slid a few inches in the gravel although the wheels on the opposite side had left no mark.

"WHEN the four-wheel brakes on one side are too tight you are all set for some extra fancy skidding.

"If you want to get the brakes even, you've got to jack up both rear wheels at the same time and have somebody put on the brakes while you test to make sure that both brakes take hold at the same time. If you haven't anyone to help you, rig up some blocks of wood and use your jack to push the brake pedal down a little at a time.

"And," Gus continued, "you can pull on a husky spring balance hooked into the spokes near the rim to match the effect of one brake with the other. That is a really accurate method.

"THEN when you have the rear brakes right, remove one jack and raise a front wheel and test it. The front brakes should take hold a little after the rear ones and they shouldn't hold so tight. If they lock before the rear ones, you are mighty liable to get into a dangerous skid. After you have one front brake right, you can transfer the other jack to the front and match the other front brake."

"Why not just shorten the brake rods by turning the clevises?" suggested Green.

"Whatever you do, don't do that!" Gus replied most emphatically. "Don't ever monkey with the length of the brake rods. Changing their length throws the leverage of the whole system out of whack so that you'll have to push a whole lot harder on the brake pedal to get the same amount of braking effect."

"Can you fix 'em for me this morning?" asked Green, sheepishly.

"Soon as I finish this job I'll get at it—by the way, didn't I hear you say you had adjusted the carburetor?"

"You did," Green admitted.

"Then," grinned Gus, "I'll fix that too!"

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RADIOTRON UX-199 *Detector Amplifier*
RADIOTRON WD-11 *Detector Amplifier*
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RADIOTRON UX-200-A *Detector Only*
RADIOTRON UX-120 *Power Amplifier Last Audio Stage Only*
RADIOTRON UX-222 *Screen Grid Radio Frequency Amplifier*
RADIOTRON UX-112-A *Power Amplifier*
RADIOTRON UX-171-A *Power Amplifier Last Audio Stage Only*
RADIOTRON UX-210 *Power Amplifier Oscillator*
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This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

You May Find the One Idea You Need Here

Five Quick Motor Car Tricks

Does the Rain Drown Your Motor? Is the Window Cracked? Do Insects Clog Your Radiator? Here's How Others Fixed It

GENERALLY when your motor refuses to start after a heavy rain it is because water has leaked through the hinge joining the two sections of the hood. Fig. 1 shows how a gutter of sheet iron or, preferably, brass can be constructed to carry the water harmlessly away.

Fixing Broken Window

BROKEN or cracked glass windows on an automobile are dangerous as well as unsightly. If the glass has broken in a clean crack, without shattering at any point, it can be repaired so that the crack will hardly be visible, as shown in Fig. 2.

Obtain a good grade of transparent glass or celluloid cement and a sheet of celluloid. Remove the glass and cement it at the cracks, laying the glass on a perfectly smooth surface if possible. Next, with a soft brush, paint the surface of the glass with the cement. Lay on the sheet of celluloid smoothly to avoid air bubbles. Place a smooth board on the celluloid with weights on top of it until the cement has dried.

A Radiator Screen

TO END the nuisance of insects in your radiator when the pests swarm in summer, keep them out with close-mesh window screening as shown in Fig. 4. After cutting to size, the screen is held in place at several points by wires threaded through the holes in the radiator.

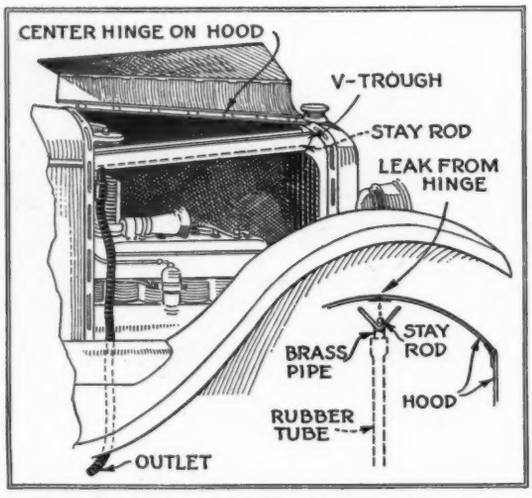


Fig. 1. This easily constructed rain gutter catches drops of water that leak through the hinge at the top of the hood, and carries them to the ground through a pipe.

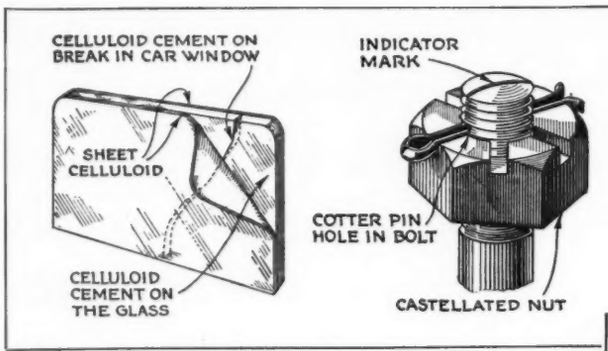


Fig. 2 (at left) shows a neat way of repairing a cracked window with sheet celluloid. Fig 3 (at right) is a time-saving idea for locating a cotter-pin hole by a mark on the bolt.

A Quick Way to Find Cotter-Pin Holes

WHEN the bolt and nut are greasy and the light is not particularly good, it is extremely difficult to find a cotter-pin hole.

A time-saving and ingenious idea is to file an indicator mark across the end of the bolt exactly in line with the cotter-pin hole, as shown in Fig. 3. Then you can line up the slots in the castellated nut with this mark and know that the cotter-pin hole will be exactly in line.

How to Get Rid of Annoying Fumes

IF YOUR car lacks a device to carry off fumes from the crank case and prevent their entering the body of the machine, you can fit such a device as shown in Fig. 5. A half-inch pipe is brazed or soldered into the side of the oil filler pipe and the end of it brought down below the motor. The holes in the cover are plugged.

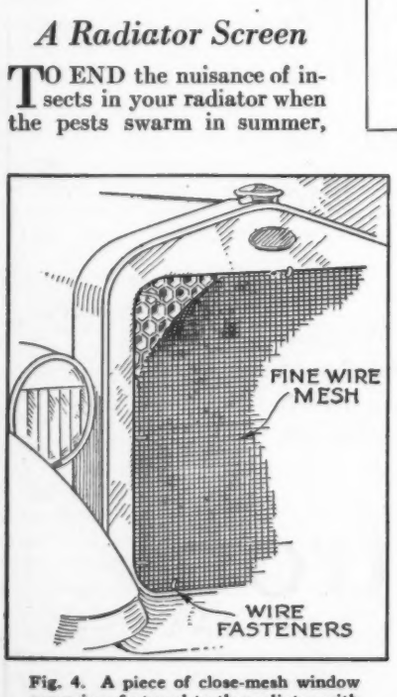


Fig. 4. A piece of close-mesh window screening, fastened to the radiator with wires, keeps insects out of the openings.

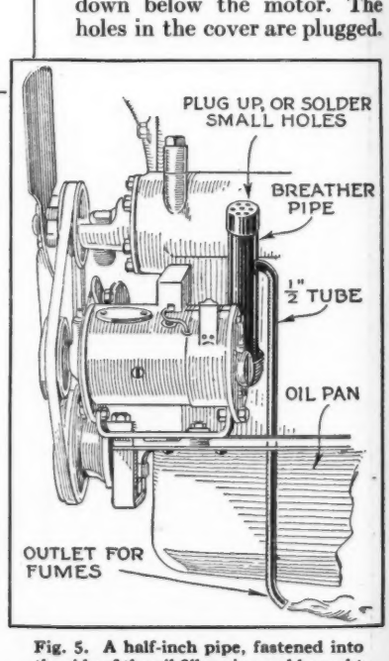


Fig. 5. A half-inch pipe, fastened into the side of the oil filler pipe and brought downward, carries off crank case fumes.

Ten Dollars for an Idea!

THIS month's prize for the most valuable idea for motorists is awarded to Clarence Clevenger, of Santa Clara, Calif. His contribution, a time-saving kink for locating cotter-pin holes, is shown in Fig. 3 and described elsewhere on this page.

Each month Popular Science awards $10, in addition to regular space rates, for the idea most useful to car owners. Other contributions published are paid for at our usual rates. What particular piece of originality has added to your motor car enjoyment? Write it down and send it to the Technical Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

The "high spots" of my life are in those reels

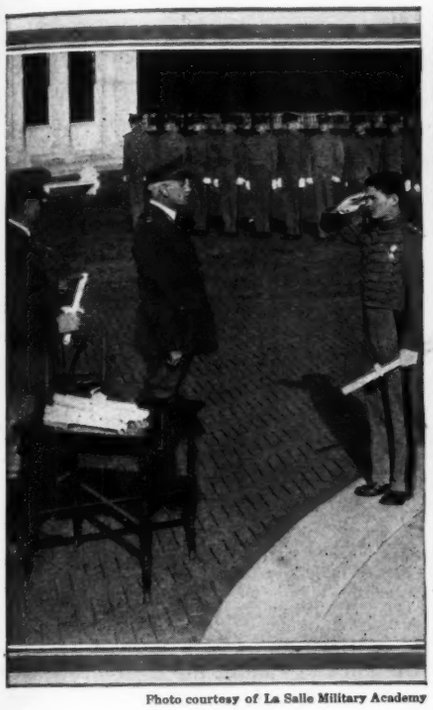


Photo courtesy of La Salle Military Academy

"THE thought first came to me years ago . . . one day as I sat in a movie theatre watching a news reel. A mayor threw out the first baseball of the season; a governor laid a cornerstone; a president addressed the multitude; boxers signed up for fights; runners broke records; foreign celebrities came down gangplanks.

"If I were one of these much-filmed people, I said to myself, I'd arrange to get a copy of all the shots they took of me. Then I'd put them together in one reel and call it 'The High Spots of My Life.'

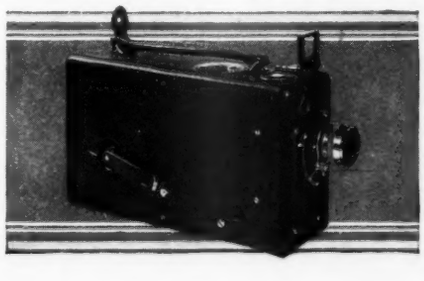
"Just a week later, a real coincidence came about. For my birthday, my father presented me with one of the first Ciné-Kodaks. At once it occurred to me, that even though News Reel Feature cameras should never be aimed my way, I could now make my own film of life's high spots.

"Not long afterward, Commencement Day arrived, the climax of a wonderful four years at prep school. That was indeed a high spot, and my Ciné-Kodak got every bit of it. I left college to be married, another of those events that usually occur but once in a man's life. My wedding made another thrilling reel.

"I was out on the Coast when our baby was born, and it was months before I could leave. You can imagine how impatient I was to get back home, and what that one moment was like when, for the first time, I held my baby in my arms. But, of course, that big moment doesn't have to be imagined. I can turn on my Kodascope and show it to you on the home screen. You can see me, the youngster on my knee, almost bursting with pride."

How would you like to sit in your own living room and watch events flash by that happened years ago and in which the leading part was played by you?

Thousands of Ciné-Kodak users are now having that very experience. Home movies have been made as simple as snapshots. Unbiased by the precedents and prejudices of professional cinema camera design, the men who made still photography so easy have now made home movie making equally simple for you. The result is that the Ciné-Kodak is the simplest home movie camera.



As for Ciné-Kodak Film, it is extremely inexpensive because *the cost of developing is included in the price.* Projection is just as easy as photography. That, too, has been simplified by Eastman methods. It takes no more skill to operate a Kodascope than to run a phonograph, and the pictures on the screen are so distinct and lifelike that you marvel at having taken them yourself.

You will find a demonstration of home movies extremely fascinating. Stop in at your Ciné-Kodak dealer's and ask him to tell you about the Ciné-Kodak. Or send for interesting booklet.

* * *

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Please send me, FREE and without obligation, the booklet telling me how I can easily make my own movies.

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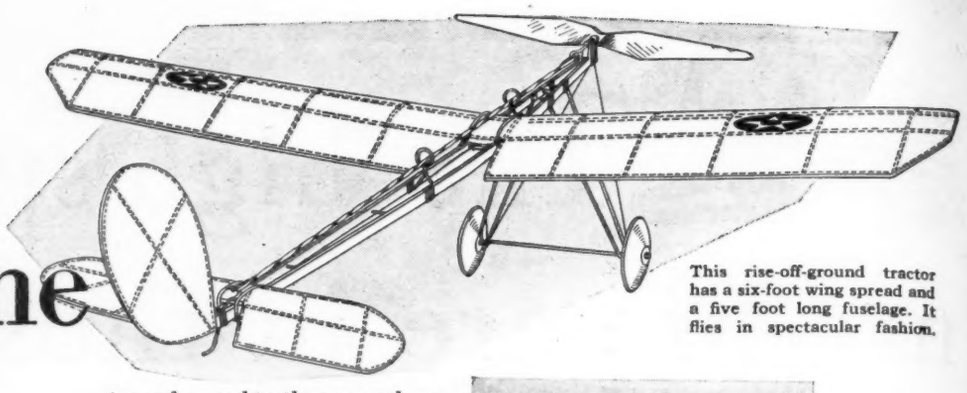
Giant Model Airplane



This rise-off-ground tractor has a six-foot wing spread and a five foot long fuselage. It flies in spectacular fashion.

By
J. DANNER BUNCH
and AVISON F. KOCH

IF YOU wish to give your neighborhood, school, or model club a real thrill, build a giant airplane model like that illustrated. Only by seeing the enormous model soar away in flight can one realize the sensation it creates among the spectators. And as for the builder—he has not only the joy of flying it but also the satisfaction of having assembled a model that closely approaches a full size airplane in many particulars of its design and construction.

The fuselage is the two-stick, tapered type. The 5-ft. longerons are made of white pine; they are 3/16 by 3/4 in. at the greatest depth, which occurs at a point 12 in. from the nose. This is the point where the rear undercarriage struts are attached, and where the greatest strain occurs. From this point the longerons taper forward to the nose, where they are 1/2 in. deep and 3/16 in. wide. From this same point the longerons also taper toward the rear end, at which place they are 1/2 in. deep and 3/16 in. wide. Make an angle cut 3/4 in. long at the nose so that they fit together snugly, and glue and bind them together with a few wraps of silk thread.

The compression struts are made of bamboo 3/32 by 1/8 in. The front strut is located 9 1/2 in. from the nose and holds the longerons 2 in. apart; the second strut, 25 1/2 in. from the nose, holds them 2 1/2 in. apart; the third strut, 39 1/2 in. back, holds them 1 3/4 in. apart; the fourth strut, 53 1/2 in. back, holds them 3/4 in. apart. The ends of the struts are sharpened wedge-shape and glued and forced into slits in the longerons. These slits are made by forcing the point of a knife blade into the side grain of the wood.

Make an angle cut at the rear of the longerons 1 1/2 in. long; first true up the fuselage by sliding the longerons one way or the other; then glue and bind them with a few wraps of silk thread.

Bunch holds the model in front of him so as to give you an idea of its size. The covering of the wing is China silk.

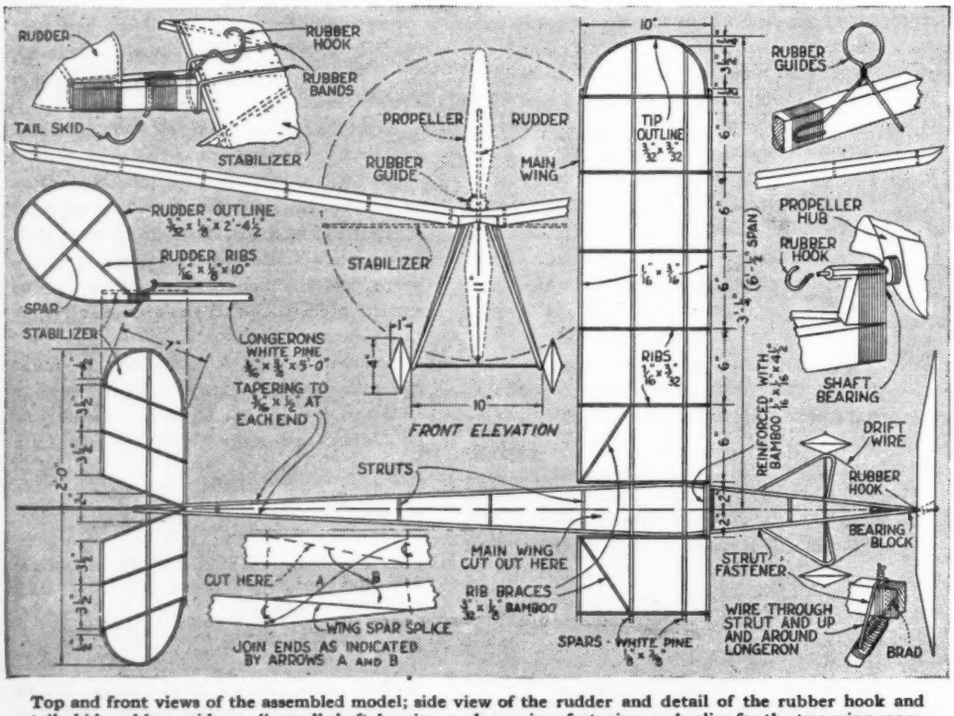
Cut a bearing block from white pine 3/16 in. thick, 3/4 in. high and 5/8 in. long at the top and 1 in. at the bottom. Groove the top to form a cradle for the bearing. The bearing is a bicycle spoke nipple. Glue and bind the bearing assembly to the top of the nose of the fuselage.

Drill a 1/16-in. hole vertically through the fuselage 1 in. from the tail. Make a hook from a 1/16-in. bicycle spoke to hold the rear end of the rubber motor; pass it through the hole and bind and glue in place. Leave 1 1/2 in. of the wire on the underside to form a tail skid.

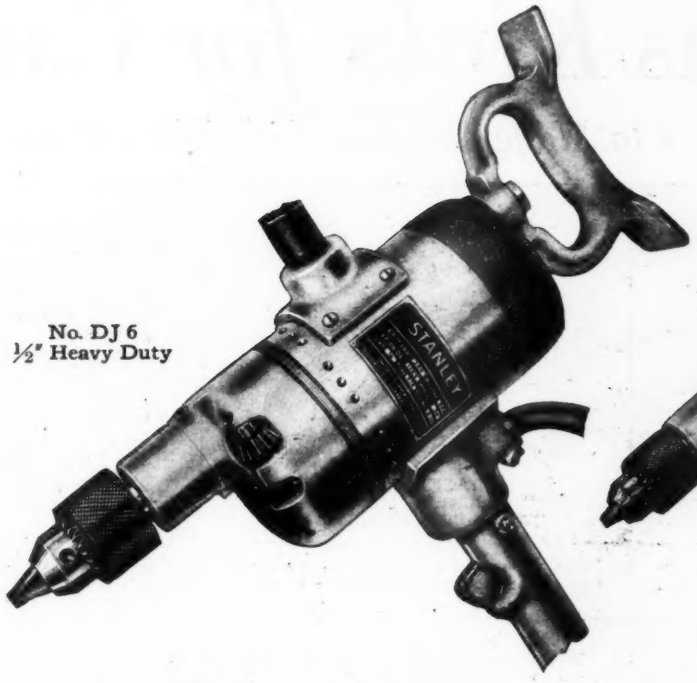
There are two rubber guides: one is 15 1/2 in. from the nose, the other is 32 1/2 in. back, and both are made of 1/16 in. diameter piano wire. To make a guide, form a ring 1 1/4 in. in diameter and bend the wires parallel to one another for 1/4 in. in the same plane as the ring. Glue and bind together here. Spread the legs until they reach the longerons and bend into an oval loop in the same plane as the longerons; bind in place with thread and glue. The wires should be just high enough for the rubber to pass through its center.

The longerons should be reinforced by binding them with silk thread at points 12 and 7 in.

(*Continued on page 109*)

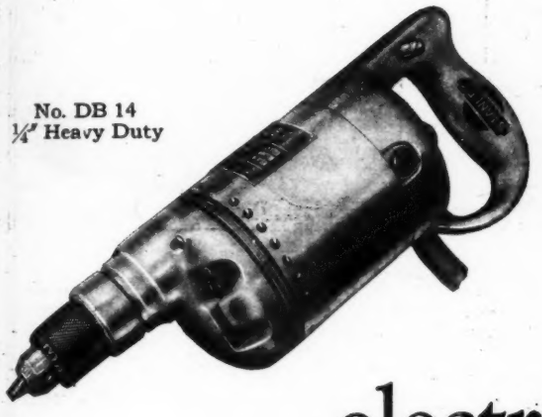


Top and front views of the assembled model; side view of the rudder and detail of the rubber hook and tail skid; rubber guides or "cans," shaft bearing, undercarriage fastening, and splice for the two wing spars.



No. DJ 6
½" Heavy Duty

No. DG 23
" Standard Duty



No. DB 14
¼" Heavy Duty

INTRODUCING
new efficiency in electric drill performance

Stanley Electric Drills will operate continuously at full rated capacity with only an 8° rise in temperature. A new and unique design in ventilating systems makes this feat possible.

Stanley Electric Drills are also equipped with exceptionally powerful motors that give adequate reserve power. Simple, compact design eliminates projecting parts and makes the drills both strong and rigid. The handle fits the hand and the switch is so placed that it can be operated without releasing the firm grip necessary to hold a drill against the work.

The new Stanley Electric Drills can be inspected at your dealer's. Try them on steel; on iron; on hard wood. You will thus prove to yourself, point by point, that they do the hardest work with the least strain or effort.

Send coupon for catalog No. Se59 which describes the full line of Stanley Electric Drills, Grinders and attachments.

The Stanley Works, New Britain, Conn.

Please send me Booklet Se59, describing Stanley Electric Drills.

Name _____

City _____ State _____

STANLEY TOOLS
The choice of most carpenters

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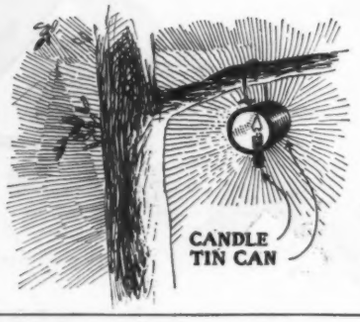
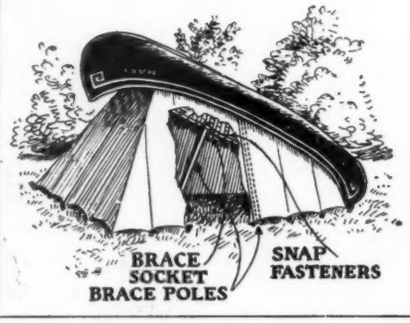
Ingenious *Kinks for* Campers

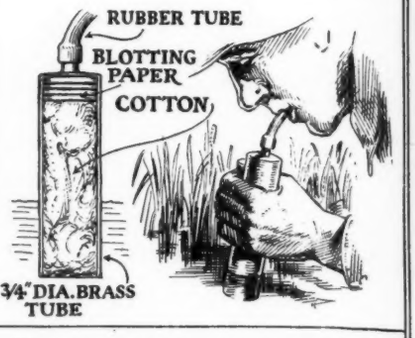
Twelve Ways to Make Outdoor Life More Enjoyable



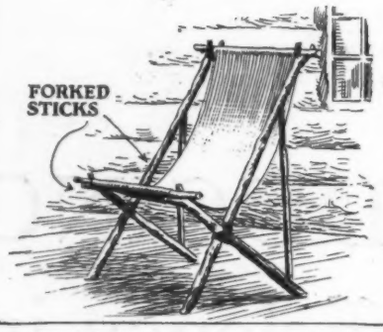
If your flashlight fails, a candle and a can will make a lantern, but watch out for fire.



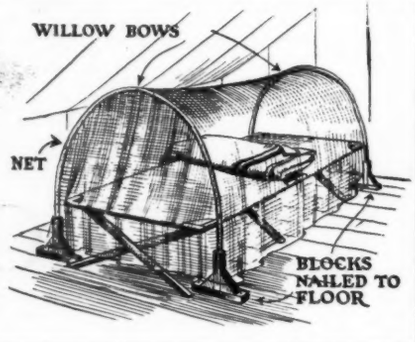
Props and special curtains convert a canoe into a waterproof shelter in times of storm.



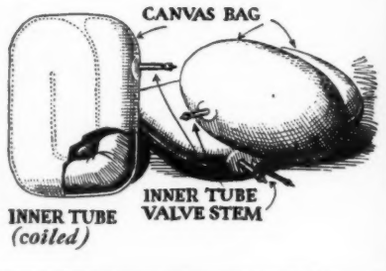
When the surface water is contaminated, this filter gives the camper a cleaner, safer drink.



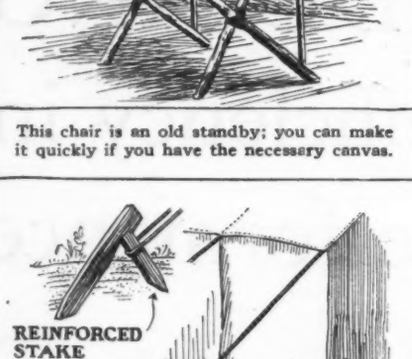
This chair is an old standby; you can make it quickly if you have the necessary canvas.



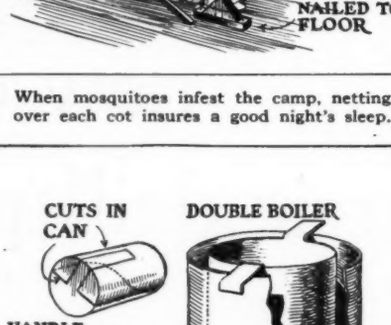
When mosquitoes infest the camp, netting over each cot insures a good night's sleep.



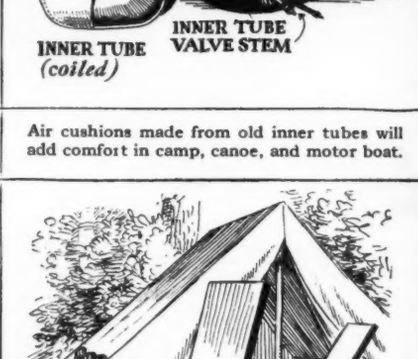
Air cushions made from old inner tubes will add comfort in camp, canoe, and motor boat.



Two simple ways to make tent stakes hold fast in sandy soil and blustery weather.

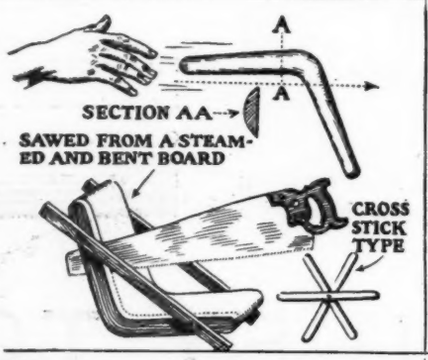


From the cans in which so much camp food comes, you can form many cooking utensils.

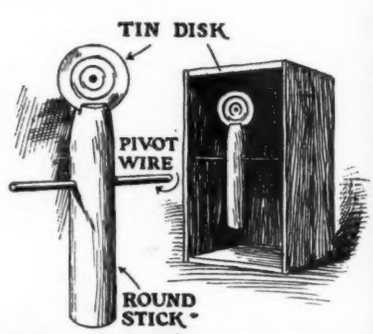


Hammer and saw, a board, a few nails—and you can make this type of chair in no time.

Oak ⅜ in. thick and tin are the materials used in making this roomy fishing-tackle box.

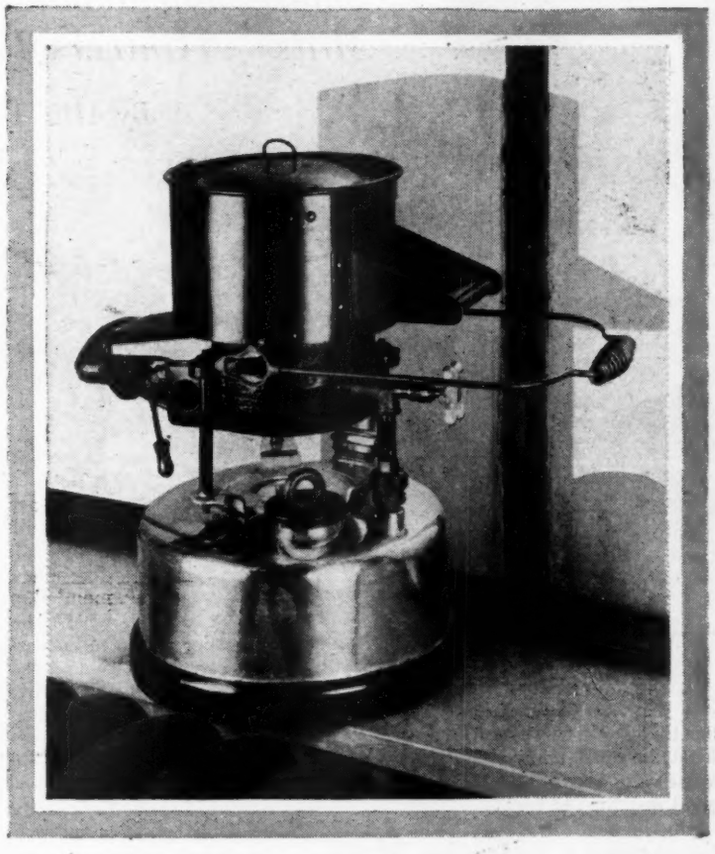


There is more interest than ever in throwing the tricky boomerang. Here are two types.



This target is for the boy who takes his air rifle to camp. The disk bobs whenever hit.

This is the Clayton & Lambert No. 70 fire-pot with tinner's hood. Produces a working flame in ninety seconds. Flame controlled as easily as a lamp. The burner orifice cannot be enlarged by tightening the needle valve. No chance of ruining the fire-pot that way—that's an exclusive C & L feature. Will heat a pair of soldering coppers and melt a pot of metal at the same time.



On the job, *when you want it . . .* all the time

WHEN you're in a hurry; when you're working in a high wind; when it's bitter cold; when you've got an indoor job—any time you need a fire-pot you'll be better off if it's a Clayton & Lambert.

You can light it and have it heating things up for you in ninety seconds! Your generator is shielded from wind! And it's so fast-acting that cold weather can't slow it up. And if you're using either Clayton & Lambert No. 70 or No. 60 you've got such a quiet fire-pot you can't disturb anybody. Of course No. 22, the coil fire-pot, makes a bit of noise—but you can't expect such a tremendously powerful blast as that to whisper!

And here's something. They're built like a battleship, as far as strength goes. Everything rugged. Made for hard, rough work. Just take a look at that bright red, protecting ring around the base of the tank, if you want to see how we make Clayton & Lambert fire-pots give you long service, free from trouble.

But in spite of all that extra strength and protection, they're lighter than fire-pots have been. You won't get round shouldered carrying these around.

Just remember that name Clayton & Lambert next time you're buying a fire-pot. If you've got a fire-pot now that gives you exceptionally good service, take a look and see if you don't find the Clayton & Lambert name on it! And we can promise you better performance in the new models. See them at your regular supply house.

"PROTECTION" C&L TRADE MFG. CO. MASON

CLAYTON
&
LAMBERT
MANUFACTURING CO.
DETROIT, MICHIGAN

This is the Clayton & Lambert No. 22 fire-pot. It is deservedly popular because of its easily understood design and its powerful blast. Recent improvements and Clayton & Lambert patented features make this model particularly desirable. The burner jet is easily removed to permit cleaning and flushing of the coils. The coil cups on both bottom and sides are made in three pieces and may be quickly detached. Sturdy construction and popular price make this tool a favorite with the plumbing trade.

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Sharpening Milling Cutters

Small Shop Methods for Grinding Plain and Spiral Mills—A Universal Tooth-Rest—Clearance Angles

By HECTOR J. CHAMBERLAND

Grinding an inserted-tooth mill.

IN SHARPENING plain or spiral milling cutters, side mills, end mills, angular cutters, counterbores, and reamers, the toolmaker or machinist has to observe two essential requirements: First, he must know the proper clearance angle; and secondly, he has to provide a good rest for the teeth.

On the clearance angle depend largely the success of a milling job and the life of the cutter. I am inclined to think that it is as important as the steel from which the cutter is made, the material to be cut, or the speed, feed, and other factors. Too much clearance will weaken the cutting edges and make necessary too frequent grindings; not enough clearance will strain the spindle and arbor, reduce production, and result in a poor finish on the work.

Many cutters used today are of the coarse feed type with an average undercut or rake of about 10°. Guesswork should be eliminated in grinding the teeth. Small gages such as those shown in the diagram marked Fig. 1 on page 116 can be made quickly and will help to insure good results. A complete set of 5°, 8°, 10°, 12°, and 15° gages should be kept on hand.

The average clearance recommended for steel is 5°; this may vary about 1° either way depending upon the steel being cut. For bronze the clearance should be 8° or 9°, for aluminum from 10° to 12°, and for cast iron 6° or 7°. It follows that if a cutter has a 5° clearance angle and a 10° undercut, the protractor reading should be 15°. This obvious fact is too often overlooked with bad results.

A substantial tooth-rest is essential. One such as that illustrated in Fig. 2 has few, if any, superiors. It has a clapper-box mounting and is universal in range. The finger itself is of heavy gage stock reinforced by means of the 90° twist. The spring which acts upon the pivoted finger holder makes indexing very reliable, even when heavy cutters are being ground.

Both disk and cup wheels are used for sharpening milling cutters. If it is possible to use it, the disk wheel is to be recommended. On plain mills, where the teeth are close together, it is often necessary to use a cup wheel so as to avoid grinding off the edge of the tooth above. Also, in the case of cutters with coarse teeth, where the land has attained a width of ⅛ in., the cup wheel should be used, for the reason that the curvature resulting from the disk wheel weakens the cutting edge. The cup wheel is also valuable for renewing the secondary clearance of mills of this type, thereby retaining the land at the desired width, as in Fig. 3.

For grinding spiral mills, the tooth-rest is, of course, bolted to the wheel head and the finger relieved in the center, as in Fig. 4. The finger should be wide enough to project ⅛ in. at each side of the wheel.

A FINGER to be used for sharpening alternate teeth milling cutters is illustrated in Fig. 5. Its shape allows both angles to be ground at the same setting. The cutting edge of the wheel should not be more than ⅛ in. wide, and while grinding the teeth it should not pass beyond the center of the finger.

The top teeth of side mills are ground with a disk wheel. The tooth-rest may be used on the wheel head or on the table, as in Fig. 6. A cup wheel is used for the side teeth. The set-up is the same as for the end teeth on end mills, only a stud is used instead of a cylindrical bar. A clearance angle of 2½° is desirable for the work, although in some cases a clearance of from 2° to 5° is recommended. The grinding should be either square with the top or concaved from .005 to .001 in.

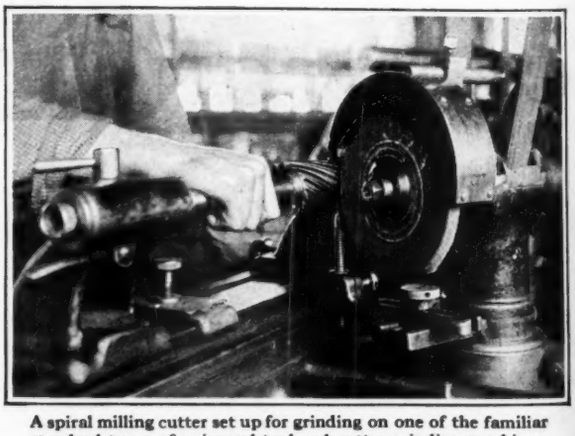
End mills require special attention. When new, these tools are ground cylindrically on the body to within .005 in. of their finished size. They are then cleared, this operation being done to eliminate the burr and save the temper. In resharpening end mills the same results may be obtained by following the method shown in Fig. 7. Note the running direction of the wheel and the position of the tooth-rest. The operator must be careful to hold the tool steady against the finger. A dog is clamped on the shank of the mill to make the operation more convenient.

The set-up in Fig. 8 is for a left-hand mill with a left-hand spiral; in Fig. 9, for a right-hand cut with a right-hand spiral. Right-hand teeth are done on the front edge of the wheel, left-hand on the rear edge.

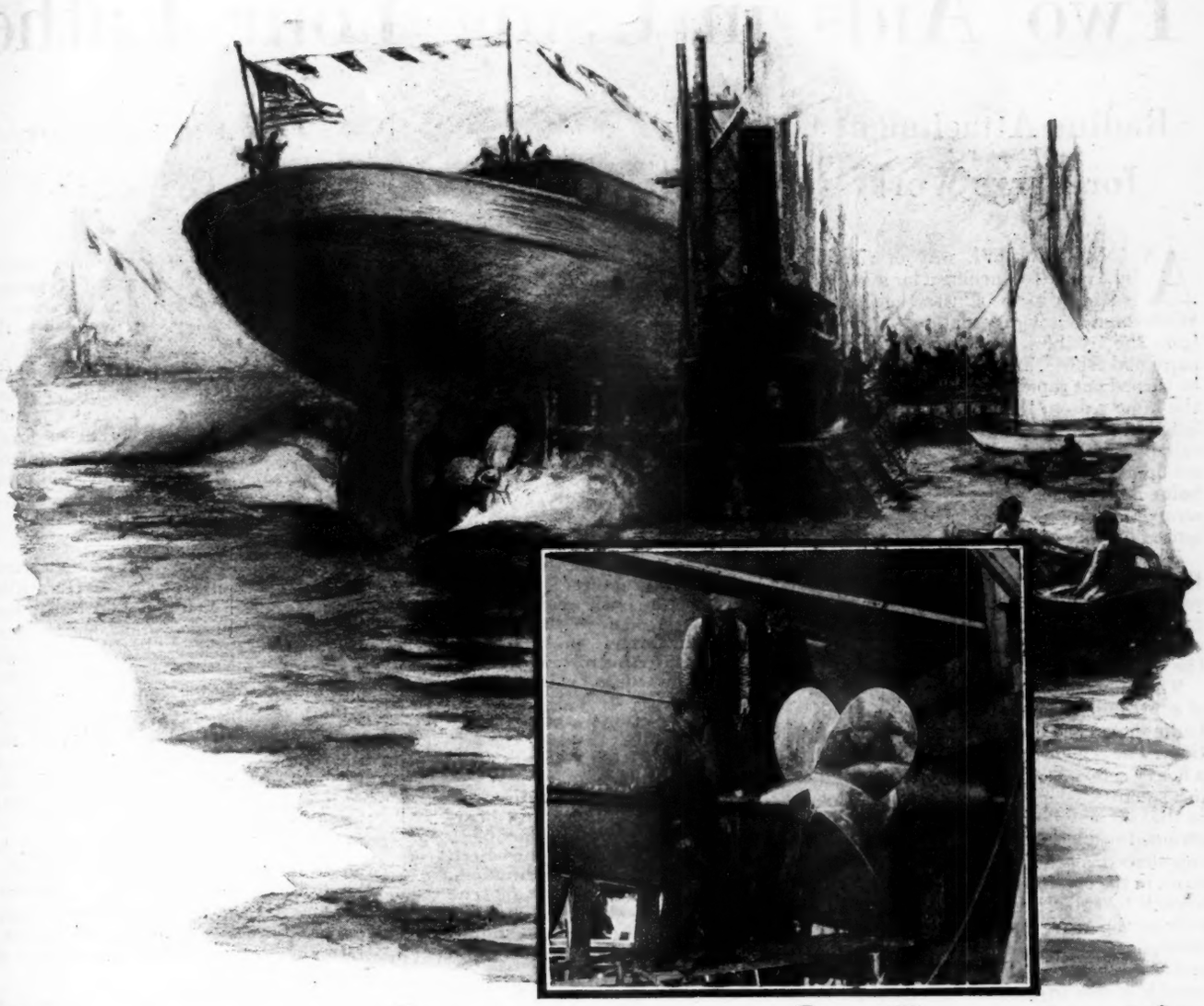
For grinding end mills with a threaded center hole in the shank end, a centered screw should be used, as in Fig. 10.

In sharpening counterbores, the important factor is to have the teeth square or slightly convex, as a slight concavity on the work will do no harm. As shown in Fig. 11, a cup wheel is recommended as it makes it easier to obtain a square corner near the pilot.

GRINDING the teeth on angular cutters presents an opportunity for argument. An angular cutter may be considered as a number of plain milling cutters of different diameters ganged together, for which reason some mechanics give the preference to the disk wheel. The fact is that when any cutter is ground with a cup wheel and the regular vertical attachment is used, the clearance angle is determined by the diameter of the cutter; whereas, when the disk wheel is used and the same method followed to obtain the clearance, it is not the cutter but the grinding wheel which is the varying factor. In deciding which wheel to use, both the thickness of (*Continued on page 116*)



A spiral milling cutter set up for grinding on one of the familiar standard types of universal tool and cutter grinding machines.



Down to the sea with Starrett's

From the ways at Lawley's yard slides the largest Diesel powered yacht ever built. Up through Belle Isle races forty feet of spray hidden Mahogany. Off Montauk an express cruiser maintains her steady twelve knots.

Every shipyard is equipped with Starrett Tools. Marine machinists and carpenters have come to rely upon Starrett accuracy that the development of marine transportation may keep pace with that of land and air.

In industry or in the home shop, wherever accuracy and good workmanship count, you'll find Starrett Tools the favorites. Write for free copy of Starrett Catalog No. 24 "W"

THE L. S. STARRETT CO.

World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes—Standard for Accuracy
ATHOL, MASS., U. S. A.

Use Starrett Tools

2093

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Two Aids in Using Your Lathe

Radius Attachment for Large Work

AN INEXPENSIVE way of rigging up a lathe for turning a large radius is shown in the illustration below. While of a temporary nature, it is free from the troubles which usually accompany makeshifts, and enables the work to be turned out rapidly and accurately. For the same reason, the arrangement is well adapted for handling a number of duplicate pieces. Once made, it can be quickly set up at any future time. A few machine bolts, a bar of heavy flat stock, and some scrap pieces of steel are all that are required by way of materials.

The swing of the radius is obtained by the cold-rolled flat bar *A*. This carries a regular lathe bit *B* at the front end and is pivoted at *C*, while it can make a radial sliding movement along the fulcrum *D* on the compound rest.

The manner of holding the cutter and of controlling the radial movement of the bar is shown in Fig. 2 of the same illustration. The regular tool post is replaced by a heavy screw *E*. The head of *E* is seated in a square washer *F*, which fits the T-slot in the compound rest. Screw *E* is solidly clamped in place by a nut *G* seated in a cup-shaped piece *H*, there being enough space in the cup to allow a hexagon socket wrench to enter it. A washer *I*, which rests on top of *H*, supports the bar *A* and determines the elevation of the cutter, and a similar washer *J* on top of the bar is capable of fine adjustment up or down by means of a nut *K* and a locknut *L*.

Bar *A* is formed with a radial slot *M*, which permits a snug sliding movement to a collar *N* placed over the stud and resting on the lower washer *I*. Running into this slot *M* is an inclined slot *O* for accommodating the lathe bit *B*, which is clamped in the regular way by a set screw *P* located in a crosspiece *Q* screwed to the front end of bar *A*.

The pivot or radius-center *C* is in the form of a pin fitting a hole in bar *A* and located in the top of the movable jaw of a milling machine vise *S*. This is firmly fastened down to any convenient suitable support, such as a heavy and rigid workbench, or a shop truck with the casters removed and well braced and weighted.

WITH the arrangement so made, turning the radius is an easy matter. Of the two distances which make up the radius, distance *Y* remains constant, and the short distance *Z* is easily obtained by slight shifts in the position of the tool, so that a very accurate adjustment of the radius is not only possible, but is easily maintained and reëstablished whenever it becomes necessary to grind the bit. The screw adjustment of the vise allows the tool to be fed in as positively as if it were done with the regular feed screw.

Radii of extraordinary length can be turned in this manner without difficulty. Where the length of the bar is considerable and it has a tendency to sag, a light timber, "crown" side up, may be clamped on top of the bar over the greater part of its length.

Another valuable lathe accessory is shown in Fig. 1 of the right-hand illustration below. It is a long tailstock center. While it costs little to make, it will be found useful in any shop where grinding has to be done on (*Continued on page 117*)

Old Bill *Says*—

¶ If you work to close limits, once a week you should have your micrometer tested at every one-tenth reading.

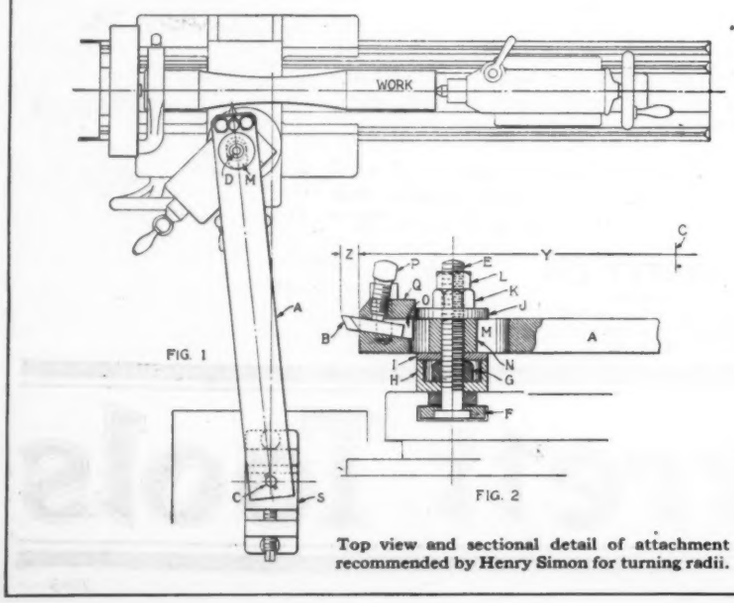
¶ Don't always blame the milling cutter—or even yourself—if it runs out; half of the time the trouble is in a sprung arbor.

¶ Worn screw slotters, ground cylindrically and to the required angle, make very good slitting disks.

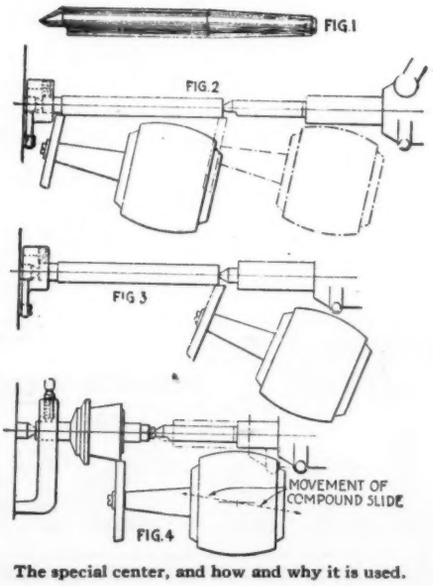
¶ In cylindrical grinding, although the spindle and bearings of the machine may be in first-class condition, the wheel, as is well known to toolmakers, is thrown slightly out of true when stopped even for a few seconds. Therefore it should be dressed off each time before any grinding is done.

¶ If you have served your time in Smith's and think you know the game, just go over and work in Brown's shop, and learn as much again.

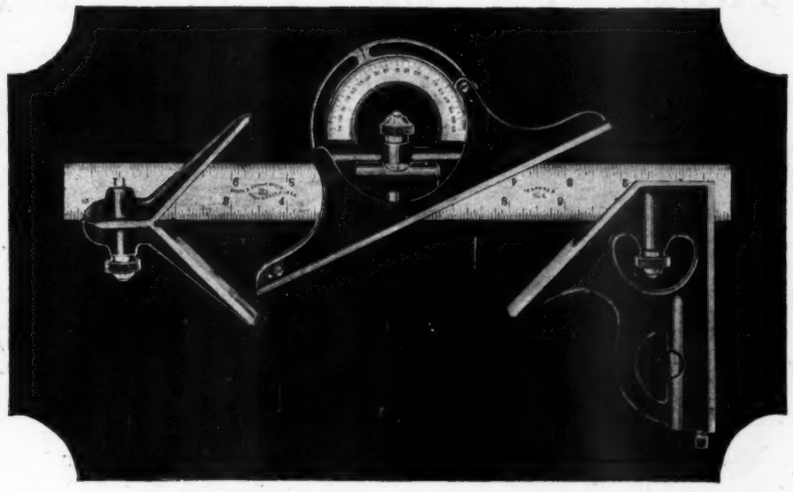
Tailstock Center for Grinding



Top view and sectional detail of attachment recommended by Henry Simon for turning radii.



The special center, and how and why it is used.



Brown & Sharpe Combination Set No. 438, illustrated above, has tempered blade and reversible protractor head. The level is accurately set. A high class tool for the work intended.

The Traditional Choice for Careful Work

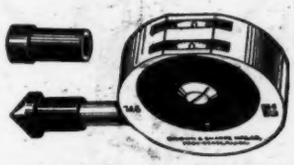
Many a skilled worker today has been "brought up" so to speak, on Brown & Sharpe Tools. Among the mechanically expert, it has become traditional to link the name of Brown & Sharpe with fine workmanship and unfailing accuracy.

The tradition persists because the quality persists. Brown & Sharpe Tools continue to satisfy the most exacting demands of the mechanic — to do the hardest work in the most accurate and practical way.

Get Catalog No. 30 listing 2300 Brown & Sharpe Tools and over 5,000 items at your hardware dealer's; or write direct to us for it. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

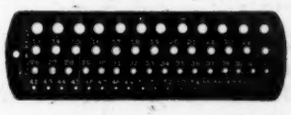
BROWN & SHARPE TOOLS Ⓢ

* MICROMETER CALIPER
No. 11 RS



* VEST POCKET SPEED INDICATOR
No. 746

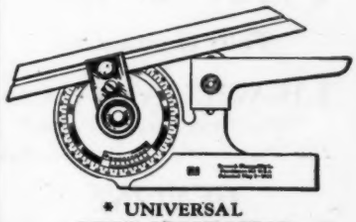
* DIAL TEST INDICATOR
No. 733



* TWIST DRILL AND STEEL WIRE GAUGE
No. 705

* RULE DEPTH GAUGE
No. 615

* AUTOMATIC CENTER PUNCH
No. 771



* UNIVERSAL BEVEL PROTRACTOR
No. 496

**A description of this tool appears in Catalog No. 30*

"WORLD'S STANDARD OF ACCURACY"

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GENUINE WILLIAMS' "VULCAN" The Original Chain Pipe Vise

ECONOMIES in manufacture, due to greatly increased production; have made possible a reduction of 20% in the price of "Vulcan" Chain Pipe Vises. Genuine "Vulcans" now sell as low, or lower than less desirable and inferior imitations.

"Vulcans" are made entirely of wrought steel—no castings are tolerated. Drop-forged Jaws are saw tempered for file sharpening. Unbreakable, light, compact, rapid in action, positive in grip. Will outwear any ordinary vise made.

Sold by the best dealers.

No.	For Pipe, Size	Weight lbs.	Price Net f.o.b. Buffalo
1	1/8 to 2	4	$2.52 each
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CHAIN PIPE VISE

Tables for the Wood Turner

Two Designs to Help You in Mastering Lathe Work

By HERMAN HJORTH

Fig. 1. When tilted down, the top of this table is supported by a graceful pivoted wing.

IN NO other way can you turn your wood turning to better advantage than in making legs for decorative tables. Rarely has a home too many small tables; there is always room for a graceful occasional table like that illustrated in Fig. 1 or a book-trough end table such as is shown in Fig. 3.

The occasional table with its folding top may be used, as its name implies, for different purposes and in a room with almost any type of furniture. When folded, it takes up the minimum space but still remains an ornament. Because of its adaptability, it is particularly suited to modern requirements.

Three turned parts are required: two uprights exactly alike, which are glued into the feet, and one stretcher connecting them (Fig. 2). The uprights have two square parts and the stretcher three. As to the method of turning, refer to the directions given in the previous article on making a footstool (August issue, page 94). After those portions which are to be turned are finished and the cuts at the square parts have been made, round the corners slightly with a skew chisel held flat on the T-rest. Lay off the distance of the rounding—about ⅜ in.—by squaring lines on all sides of the square pieces. Proceed cautiously with the cutting as shown in one of the views of Fig. 4.

A plain square rail, the same length as the stretcher, is used between the legs at the top. The joints may be made with either dowels or mortises and tenons. To this upper rail the top is hinged. Between the rail and the stretcher is pivoted the winglike table top support. Notches are cut on opposite sides of the rail to receive the projections at the upper part of the wing when it is turned parallel to the rail. The wing support is cut from ½- or ⅜-in. plywood and a ¼-in. dowel is glued into each end to enter corresponding holes in the centers of the top rail and the stretcher. If desired, an additional turned rod may be inserted in the wing as suggested in Fig. 1. Obviously, the wing must be put in place before the table is glued together. *(Continued on page 100)*

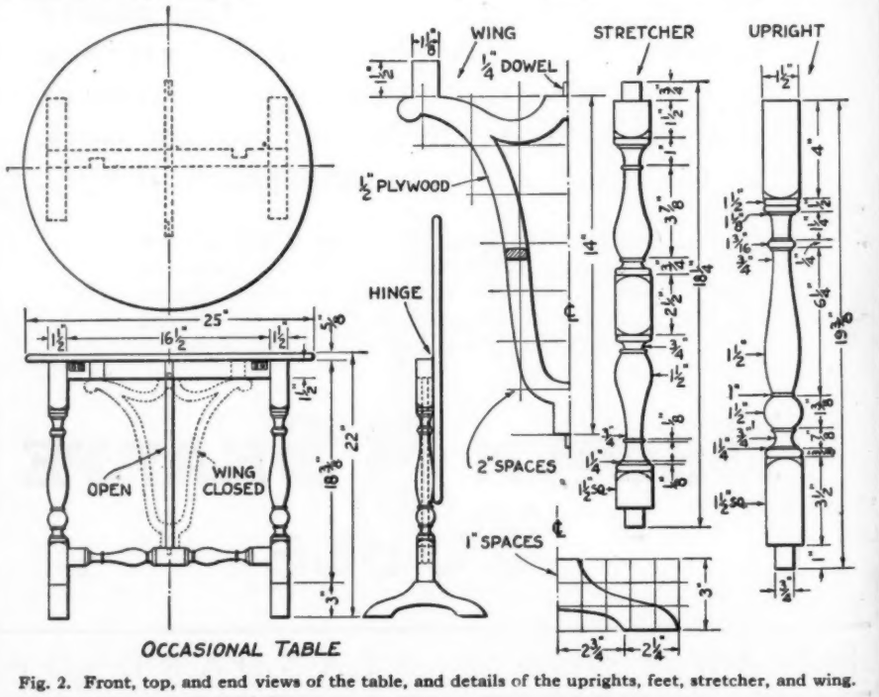

Fig. 2. Front, top, and end views of the table, and details of the uprights, feet, stretcher, and wing.

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new LIGHT WEIGHT 1/2 in. Electric Drill!

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Every MILLERS FALLS drill offers the finest value 60 years of fine tool making can give.

We challenge direct comparison with any other drill made. Buy on performance. Our dealer will arrange a test.

Less Weight — More Power

POWER — that's what a good drill gives. Power does the work. This new MILLERS FALLS has more *power*. Full ½ inch in steel capacity. No overheating. Long life. Stamina to stand hard use.

WEIGHT — that's what makes a drill harder to use. This new MILLERS FALLS is stripped for action. No unnecessary weight. Nothing but strength where needed.

only $54.00

So you'll find it easy to use this drill. You'll like its speed and power. You'll like the light way it handles. Now you'll do every job that comes along with less strain. And all for only $54.00. Never before such amazing drill value. Try it out. See your dealer for demonstration or write direct.

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The preference given STAR BLADES by the modern mechanic is more than ample proof of their superiority and ability to cut faster, better, with less breakage.

The Star on a Hack Saw Blade is your assurance of a better blade . . . . a blade that all skilled workers rely upon.

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Ⓢ

STAR HACK SAWS

Back Yard Chute-the-Chutes

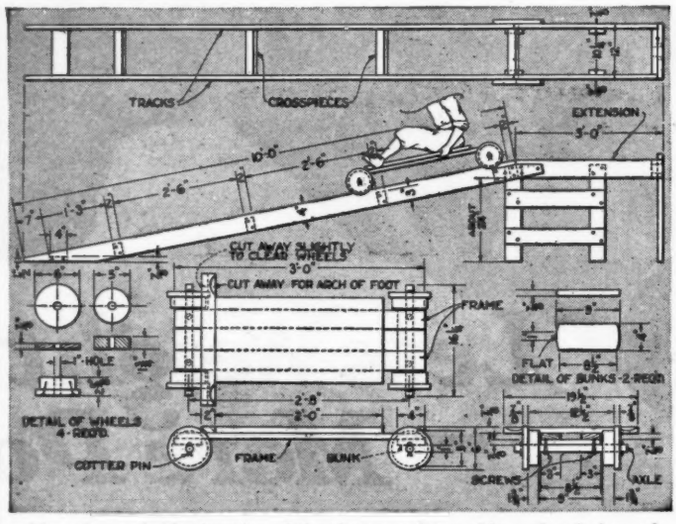
WITH odds and ends of boards, a few tools, and a moderate degree of that desirable trait "gumption," any boy can build toy "chutes" which will give him and the "gang" hours upon hours of pleasure.

Nail the tracks to the crosspieces, place the resulting ladderlike frame upon a box or a built-up support, and cut the bottom of the rails to fit the walk. Also build the 36 in. long extension upon which the car is placed at the beginning of the run.

Make the floor of the car as shown and cut and attach the "bunks" to which the broomstick axles are fastened with round-head screws. To make the wheels, cut out with a compass or fret saw four disks of ⅛-in. wood 6 in. in diameter and four of 1¾-in. wood 5 in. in diameter. Nail them together in pairs and bore a 1-in. hole through them to fit the axle. Apply paraffin, wax, or hard soap on the axle, put the wheels in place, add washers if large enough washers can be obtained easily, and then use cotter pins or drive in plain pins to hold the wheels in place.

In some localities it will be possible to move this amusement device to the edge of the "ol' swimmin' hole."—CHARLES A. KING.

Boys can have their own Coney Island at home by building these simple inclined "railways."



Plan view and side elevation of the chutes; and top, side, and end views of the car with details of the two-piece wooden wheels and the axle supports.

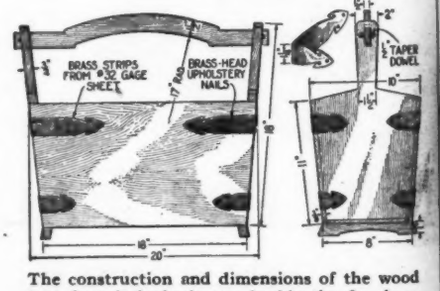
Making a Spanish-Colonial Wood Box

A handy carrier for logs for the fireplace.

THIS simply made Spanish-Colonial wood box for the fireplace has the advantage of being a carrier as well as a receptacle. It saves bringing dusty logs from the basement in one's arms.

The wood for the box should be chosen for its decorative grain. The original was made from selected pieces of old packing boxes and given a coat of walnut stain on the outside. The inside was painted a rich green which, with the brass ornaments, sets off the dark finish attractively.

The corners of the handle were rounded to give a comfortable grip, but elsewhere the angles were left sharp to carry out the Spanish motif. The brass corner strips were cut out with a pair of old shears from 32-gage brass sheet, obtainable at almost any large hardware store. Note that the two halves of each strip join at an angle, so that they will lie horizontally when bent over the corners and fastened with small brass-headed upholstery tacks.—H.S.



The construction and dimensions of the wood box; how it looks in use beside the fireplace.

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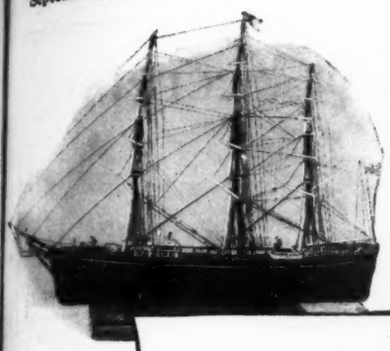

BLUE PRINTS

Woodworking and Other Projects

Price 25 cents each, POSTPAID

PRINTED below is a list of interesting and unusual projects that can easily be made at home with simple tools, for each of which a Blue Print has been prepared by the Editor of the Home Workshop Department of Popular Science Monthly. Each Blue Print gives complete working drawings of the project with the essential details full size wherever possible, and, in addition, a complete bill of materials. Use the coupon for ordering Popular Science Blue Prints.

No.	Title	Published
1.	Sewing Table	Feb., '22
2.	Smoking Cabinet	*Mar., '22
3.	End Table	*Apr., '22
5.	Kitchen Cabinet	*May, '22
8.	Shaving Cabinet	June, '22
9.	Arbor, Gate and Seats	July, '22
10.	Porch Swing	Aug., '22
11.	Bench and Tilt Table	Sept., '22
12.	Electric Washer	Oct., '22
13.	Tea Wagon	Nov., '22
14.	Christmas Toys	Dec., '22
15.	Workshop Bench	Jan., '23
16.	Inlaid Radio Cabinet	Feb., '23
17.	Cedar Chest	*Mar., '23
18.	Phone Table and Stool	*Mar., '23
19.	Grandfather's Clock	*Apr., '23
20.	Flat Top Desk	*Apr., '23
21.	Colonial Desk	*Apr., '23
22.	Cabinet and Desk	*Apr., '23
23.	One Car Garage	*May, '23
24.	Gateleg Table	June, '23
25.	Canoe Sailing Outfit	July, '23
26.	Baby's Crib and Pen	Sept., '23
27.	Kitchen-Cabinet Table	Oct., '23
28.	Pullman Play Table	Nov., '23
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30.	Tool Cabinet, etc.	Jan., '24
31.	Sewing Cabinets	Feb., '24
32.	Chinese Game Table	Mar., '24
33.	Dining Alcove	Apr., '24
34.	Garden Trellises	May, '24
35.	Simple Radio Cabinet	Oct., '24
36.	Rush-Bottom Chair	Nov., '24
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39.	Salem Chest	*Feb., '25
40.	Small Drop-Front Desk, Sheraton Style	Mar., '25
41.	One-Tube Radio Set	May, '25
42.	Three-Stage Amplifier	*June, '25
43.	Four-Tube Receiver	*July, '25
44.	Pirate Ship Model—Hull	*Feb., '26
45.	Pirate Ship—Details	Mar., '26
46.	Galleon Model—Hull	May, '26
47.	Galleon Model—Details	May, '26
48.	Sailing Yacht Model	*July, '26
49.	Broom Cabinet	Aug., '26
50.	Airplane Model (Flying)	*Sept., '26
51.	Clipper Ship Model—Hull	*Oct., '26
52.	Clipper Ship Model—Details	*Oct., '26
53.	Clipper Ship Model—Rigging	*Oct., '26
54.	Five-Tube Radio Set	*Oct., '26
55.	Five-Tube Set—Details	*Oct., '26
56.	Bird and Animal Toys	Dec., '26
57.	Constitution Ship Model—Hull	Jan., '27
58.	Constitution—Rigging	Feb., '27
59.	Constitution—Rigging	Feb., '27
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62.	Viking Ship—Details	Apr., '27
63.	Toy Motor Boat—Hull	May, '27
64.	Toy Motor Boat—Details	May, '27
65.	Six Simple Block Puzzles	June, '27
66.	Ship Model Weather Vane	July, '27
67.	Toy Model of Lindbergh's New York-to-Paris Plane	Aug., '27
68.	Magazine-Rack Table and Book-Trough Table	Sept., '27
69.	Flying Model (3-ft.) of Lindbergh's Monoplane	Oct., '27
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71.	Console Radio Cabinet—Details	Nov., '27
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75.	Santa Maria Ship Model—Details	Dec., '27
76.	Santa Maria Ship Model—Rigging	Dec., '27
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81.	Low Power Unit for Electric Radio Set	Apr., '28
82.	Single Stick Tractor Airplane Model (30-in. wing)	Mar., '28
83.	Mayflower Model—Hull	Apr., '28
84.	Mayflower—Details	May, '28
85.	Mayflower—Rigging	June, '28
86.	Racing Airplane Model (35-in. twin-pusher type)	May, '28
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89.	Bremen Scale Flying	Aug., '28
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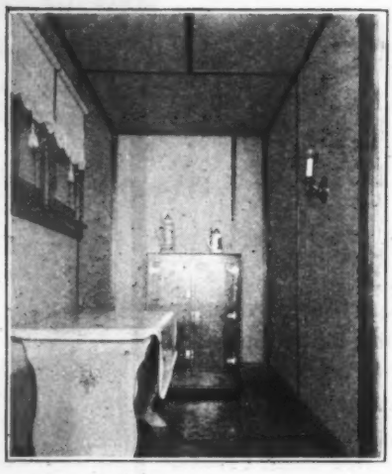
More room in the Kitchen



This enclosed porch, built with Celotex, makes an ideal breakfast room and a handy place for the ice box

WITH Celotex, you can turn open porches into kitchen additions or sun porches, at little cost.

You can change damp uninviting basements into cheerful recreation rooms for the entire family.

You can make waste attic space into a comfortable extra room for the maid or chauffeur, a study for Dad or a den for the boys.

Insulates Rooms

Celotex, made from long tough fibres of cane, stops extreme heat, cold and dampness—makes rooms more livable all year 'round.

It comes in big strong boards that are light and easy to apply. So with hammer, nails and saw you can make these home improvements yourself.

All reliable lumber dealers can supply Celotex. Send in the coupon below for two free illustrated booklets on ways to use Celotex around the house. The Celotex Company, Chicago, Ill. In Canada: Alexander Murray & Co., Ltd., Montreal.

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THE CELOTEX COMPANY
645 North Michigan Avenue, Chicago, Ill.

Please send me free your illustrated booklets "Year 'Round Comfort with Fuel Saving" and "Artistic and Useful Things *You* Can Make at Home with Celotex."

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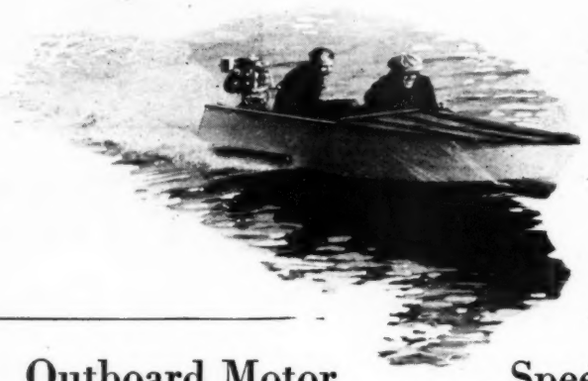
Outboard Racing Secrets

(*Continued from page 61*)



A fast hydroplane driven by a powerful outboard motor. Speeds up to 35 miles an hour are possible under the most favorable conditions with this type of hull in combination with one of the large heavy-duty motors

Outboard Motor Speed Table

(*Speed Range in Miles an Hour*)

Type of Boat (One or two occupants)	Large Twins (4-cyl. Motors)	Class C Motors	Class B Motors	Standard Twins	Light Twins	Single Cyl. Heavy Duty	Light Single Cyl.
Racing hydroplanes, sea sleds, etc., 9 to 16 ft. long	20–35	20–25	15–25	12–18	Not suitable	Not suitable	Not suitable
Square stern canoes	15–25	12–20	10–18	9–13	9–12	6–9	4–8
Light round-bottom or V-bottom boats	12–22	10–20	9–18	9–16	6–11	6–8	5–7
Heavy round or V-bottom boats 12 to 20 ft. long	9–18	9–15	5–12	4–11	3–9	5–7	Not suitable
Flat-bottom boats 12 to 18 ft. long	9–15	8–12	5–12	4–10	3–8	5–7	Not suitable
Dinghies or tenders 7 to 12 ft. long	Not suitable	9–15	9–14	6–9	6–9	Not suitable	5–6

As will be seen from this tabulation, speed depends as much on the hull as upon the motor, but the table will serve to approximate the possibilities of any hull with one of the several motors listed.

filling funnel; it should be strained through chamois so that there is no chance for dirt or water to put the carburetor out of business. Many a race has been lost through neglect of this simple precaution.

The driving gears, which are housed-in just forward of the propeller, should be given careful and frequent attention to see that they are lubricated with the right grade of gear grease, both to keep the wear on the gears at a minimum and to keep out the water, which would soon ruin the gears. The cooling system also should be checked to see that the water is circulating properly, as a too hot motor is unlikely to show maximum speed. Some motors, however, have a tendency to run too cool, although this is not common during the summer months.

The wheel or propeller furnished by the motor manufacturer is designed for the best service under average conditions. It is sometimes advisable to purchase a special racing wheel, which will let the motor turn up to its highest number of revolutions per minute. Most manufacturers will advise you as to the size of wheel you should have for your type of boat; and, as they have experimented more than the average user, their recommendations are to be depended upon implicitly.

Now that you have the right motor and a speed type of hull, there are two or three more details that should be given attention. It is essential that the wheel have free water to work to its best efficiency. This means that the motor should be so hung on the stern of the boat that no part of the boat's bottom interferes with the flow of water in an unbroken stream to the propeller. To accomplish this it is customary to cut a notch in the stern for the motor or to use a long-shaft motor if the standard length does not happen to be correct for a given boat.

Remember that the propeller should be completely submerged, both when the boat is at rest and when running at speed; otherwise the wheel will suck air and merely churn up the water. To most of the large motors is attached just above the propeller what is known as a "cavitation plate." This helps considerably to keep the propeller working in solid water under all conditions.

Distribution of weight in the boat is an important matter if top speed is expected. The motor, weighing anywhere from fifty to one hundred pounds, is as far aft as possible when it is clamped in the usual position on the (*Continued on page 93*)

Outboard Racing

(Continued from page 92)

stern. Now, if the operator also sits on the stern seat, the boat is quite likely to run along with its stem in the air. Most of the modern high-speed outboard hulls are designed so that as they pick up speed they will flatten out and run at a slight angle to the surface of the water, but it is a wise precaution to arrange the motor with tiller lines or an extra long steering handle so that the operator may trim the boat to suit running conditions. This may be accomplished in a number of ways, but the simplest is to make an extension handle of brass tubing. Remote throttle control is also highly desirable.

Air resistance plays an important part in cutting down the speed of any boat, automobile, or airplane, and much attention has been given to this phase by designers of aircraft and racing automobiles. The speed boat must necessarily be streamlined so far as possible. The fact that the outboard craft is only a few inches above the surface of the water helps to solve this difficulty. No unnecessary projection to catch the wind should be allowed above the deck line of the boat, and the driver should be low in the hull, both to keep the weight low and also to cut down wind resistance.

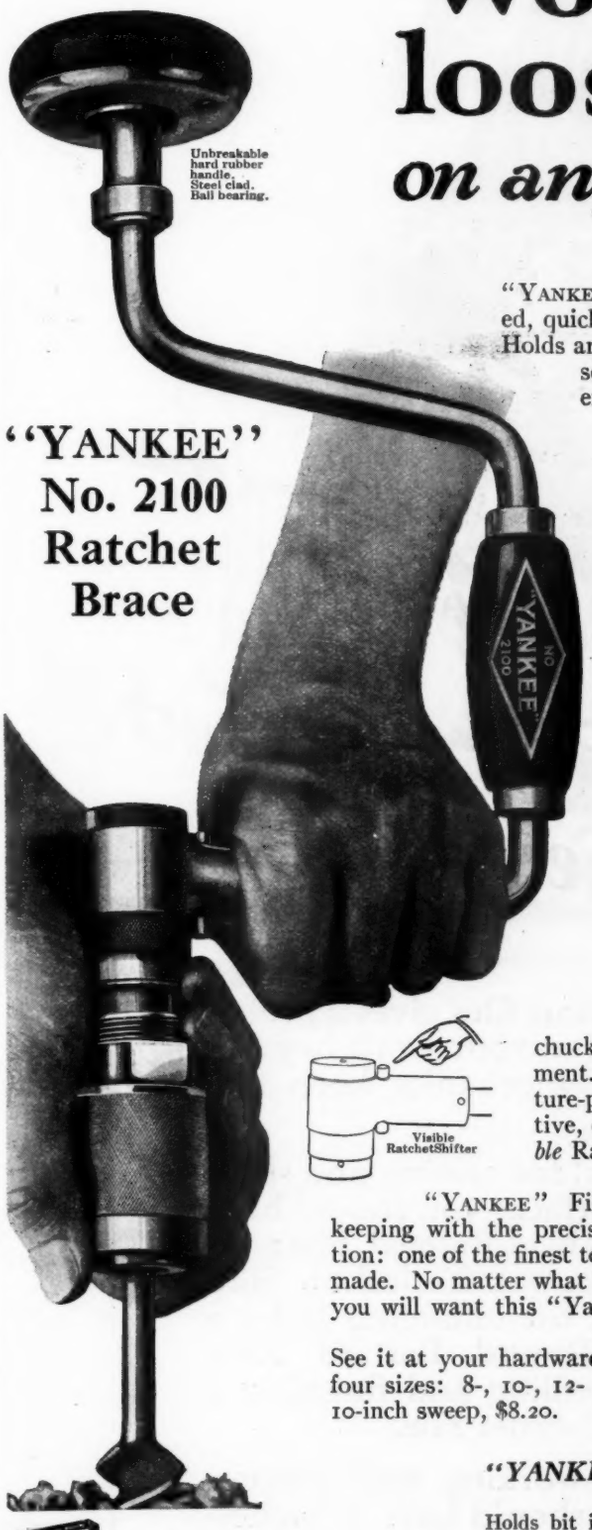
IT IS sometimes helpful to cover the forward part of the boat with a light canvas deck, if the boat is of the open type. The canvas may be stretched over battens. This serves to keep out any water that may find its way over the bow and also to shoot the air over the after part of the boat and the driver.

When many high-speed boats are maneuvering in a race, the water becomes choppy, even on a still day. The pitching of the boat cuts down its speed because of the increased surface resistance and the fact that the propeller races in the air. It seems needless to say that the smoothest water should be chosen to get top speed.

Present rules under which outboard races are being run this season call for mufflers, so it seems unnecessary to mention the use of the cut-out. It is doubtful if mufflers build up enough back pressure to make any appreciable difference in speed, but the put-put of the high-speed outboard is so objectionable to residents ashore that hardly anyone now uses the cut-out.

If the reader does not already own an outboard motor boat, he will be interested in making a good selection for his needs. There are so many different types that it is a good (Continued on page 120)

Won't loosen *on any bit*



"YANKEE" No. 2100 Ratchet Brace

"YANKEE" Chuck.—New, patented, quick centering. Ball bearing. Holds any bit accurately. Round, square, taper. Won't loosen; bit can't pull out in work. Two-jaw. Capacity up to ½-inch round and ⅝-inch square.

"YANKEE" Handles.—Hard rubber. Unbreakable. Won't warp, shrink, crack, or bind. Top handle steel clad, ball bearing. Sweep handle held by patented "Yankee" method: keeps caps in place; prevents excessive handle play.

"YANKEE" Famous Ratchet.—Smooth as the stemwind of a watch. Yet unbreakable! No need to hold chuck, on ratchet movement. Dust-proof. Moisture-proof. Quick, positive, easy-acting and *visible* Ratchet Shifter.

"YANKEE" Finish. — Strictly in keeping with the precision of its construction: one of the finest tools of any kind ever made. No matter what bit-braces you have, you will want this "Yankee" Brace.

See it at your hardware dealer's. Made in four sizes: 8-, 10-, 12- and 14-inch. Price, 10-inch sweep, $8.20.

"YANKEE" Bit Extension
No. 2150

Holds bit in socket.—No jaws to break. No loosening and pulling out of bit in work. Can't jam. Fits any brace. Follows through. Stands abuse. Lengths, 15, 18, 21, 24 inches. Prices, $2.25 to $2.40.

"YANKEE" Tool Book, Free
Write us for this book, illustrating the uses of many ingenious tools.

NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE" TOOLS

Make Better Mechanics

The Professional Touch

A rack for your files gives a professional touch to your workshop. A great many mechanics keep files that way.

In your rack, for cutting and shaping metal surfaces you should have a Nicholson Flat Bastard File; for sharpening saws a Nicholson Slim Taper File; for enlarging holes a Nicholson Round Bastard File; and for drawfiling and finishing a Nicholson Cabinet File.

For wood working and cabinet making you should have a Nicholson Cabinet File and a Nicholson Wood Rasp. Nicholson Files can be obtained from practically any hardware or mill supply dealer.

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— A File for Every Purpose

How to Drive Nails to Make Them Hold Fast

By Emanuel E. Ericson

HAMMER and nails are in common use in every household. Yet driving nails, the commonest of all mechanical operations, is not often done in such a way as to get the full holding power of the nails. A few plain facts about nails and their uses would, if they were observed, decrease the difficulties encountered and save much effort and subsequent disappointment in the failure of joints.

Fig. 1. Mr. Ericson demonstrates the proper way to use a hammer when drawing a nail.

The proper way to hold a hammer is the first important thing to learn. The amateur has the natural feeling that the less of the handle he uses, the less likely he is to miss the nail. The truth of this is not borne out in practice, however, for after one has become accustomed to holding the hammer handle at the end, as shown in Fig. 2, he will miss the nail if he tries the former method. It is safe to assume that the manufacturers of any good hammer know something about the best length of handle to use.

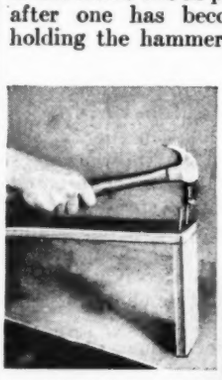


Fig. 2. (Left) Handling a hammer for straight driving.

Fig. 3. "Toe-nailing" (at right) calls for more practice.

The angle of the hammer or the "hang" of it will have to be sensed from experience. It will not (Continued on page 95).

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

How to Drive Nails

(Continued from page 94)

Fig. 4. A block under the claws of the hammer is necessary in drawing long nails.

take long before a person will automatically hold his hammer handle just low enough as the hammer strikes the nail.

Sometimes an otherwise good hammer seems to slide off the nail. At such a time it will be a good thing to rub the face of it on a piece of fine sandpaper, for it has probably become greasy.

For ordinary use, a bell-faced hammer (one with a convex driving surface) will prove the most satisfactory; it will not mar the surface when the nail is "driven home." The weight of the hammer is partly a matter of choice, although the tendency of the amateur is to try to use a hammer that is too light. From 12 to 16 oz. is the common range, depending upon the required use.

Fig. 5. How the nail set should be held.

Sharp, decisive blows will produce best results, and confidence on the part of the driver will keep nails from bending.

"Toe-nailing," Fig. 3, is somewhat more difficult than straight driving. For this it is better whenever possible to start the nails before the pieces are in the final position. Care must be taken not to slant the nails too much or they will not reach the second member properly. This is a common error of the amateur. After some practice one can drive the nails very close in a corner without scarring the wood.

Fig. 6. Skillful nailing will draw uneven boards into place.

Pulling a nail requires just as much care as driving one. The extra large supply of hammer handles at the hardware store is kept principally for those who have not learned how to pull nails. The main thing to bear in mind is the necessity of keeping the fulcrum near the nail. This is taken care of by the shape of the hammer when the head of the nail is close to the wood as in (Continued on page 96)

To new shavers

and old:

Make this 10-day test before you decide you've found the ultimate in a shaving cream that suits your face

GENTLEMEN:

When we decided to go into the making of a shaving cream we were told that men were fickle—that they changed shaving creams as easily as they changed their shoes.

But this we believe is wrong. For in the few years this new shaving cream has been sold, we find there is a peculiar loyalty to it. We find the younger generation is "going Palmolive" when it comes to shaving.

And we know for fact that the great majority of those who take our 10-day test, remain wedded to it.

If you do not know Palmolive Shaving Cream, why not send the coupon now and give us a chance to win you? You'll thank us when you know the joy it brings. And the burden lies entirely with us to prove our claims.

We first asked 1000 men

We sought, first, the shortcomings of othe shaving methods before we even started to create Palmolive Shaving Cream. One thousand men's views were asked, their answers analyzed.

Then our world-famous laboratory put its most skilful men on the problem to exceed these expectations. Time after time they failed in one way or another—129 times in all. Then success came.

These 5 important features

1. Multiplies itself in lather 250 times.
2. Softens the beard in one minute.
3. Maintains its creamy fullness for 10 minutes on the face.
4. Strong bubbles hold the hairs erect for cutting.
5. Fine after-effects due to palm and olive oil content.

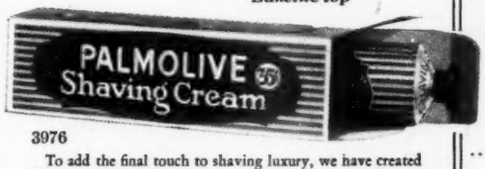
Now make the trial, please

No doubt your present shaving preparation suits you, yet there may be a better way. We've tried to find one for you, and will thank you to give it a test. Just send the coupon now.

PALMOLIVE RADIO HOUR. ***Broadcast every Friday night—from 10 to 11 p. m., eastern time; 9 to 10 p. m., central time—over station WEAF and 32 stations associated with The National Broadcasting Company.***

35c

With the new unbreakable Bakelite top



3976

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream. There are new delights here for every man. Please let us prove them to you. Clip the coupon now.

10 SHAVES FREE

and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1554, Palmolive, 3702 Iron St., Chicago, Ill.

Residents of Wisconsin should address Palmolive, Milwaukee, Wis.

.....

.....

.....

(Please print your name and address)

1929 MODELS BY HARLEY-DAVIDSON

5 BIG, NEW FEATURES

1

Two Bullet Headlights. Double lights — greater safety.

2

Generator Controller. Quick, handy control of current output.

3

Electrical Panel. Includes ammeter, parking light, and switches.

4

4-Tube Muffler. Makes exhaust wonderfully quiet.

5

Clear-the-way Horn. High frequency—penetrating, pleasing note.

BETTER equipped, better looking, better performing than ever, the 1929 Harley-Davidsons are ready now to show you the latest and finest in motorcycle design. Never before such power — such comfort — such convenience!

Motorcycle enthusiasts everywhere are flocking to the local Harley-Davidson Dealers to see the new models.

Join them there! Let your local dealer show you how much motorcycle you can buy for little money, and on easy terms. Let him give you a demonstration. If you aren't a rider already, he'll gladly teach you to ride, free.

Write us — on the coupon — for our new literature.

HARLEY-DAVIDSON MOTOR COMPANY
Department P. S. Milwaukee, Wis.

Demand for Harley-Davidson Motorcycles and Package Trucks offers to business men great opportunities as dealers. If interested, write us a letter — address Desk A 1.

1929 Single —the famous 80-mile-per-gallon solo mount—has all the new Harley-Davidson features. Sells at $235. f. o. b. factory.

HARLEY-DAVIDSON MOTOR CO.,
Dept. P. S., Milwaukee, Wis.
Interested in ☐ Twins; ☐ Single. Send literature.
Name.....
Address.....
.....

Old Stove Bowl Used as Temporary Forge

IN BUILDING a racing car at home, it became necessary to heat some heavy iron bars. The cost of a forge was prohibitive for this one job, so a forge was improvised on the spot.

An old heating stove bowl, which was badly cracked, was found in the scrap pile. A hole was made in the side where it was burned out and a piece of 1½-in. pipe inserted. The bowl was then filled with clay. The other end of the pipe was fastened to a vacuum cleaner with a blower attachment.

How a forge was quickly improvised by lining the bowl of a discarded stove with clay and using a vacuum cleaner as a blower.

In no time we had a fire that would burn up the world. The flame was so fierce we had to insert a shutter valve to regulate the air.—JACK COSH.

How to Drive Nails

(*Continued from page 95*)

Fig. 1. In this way great pulling power is applied by only a few pounds of pull, and the handle is safe.

It is after the nail comes up a distance and the fulcrum shifts toward the face of the hammer that the handle is in danger, both from less mechanical advantage and from the fact that the pull ceases to be vertical. At such a time the wise operator will take time to find a block to put under the hammer as shown in Fig. 4.

There is a trick in "setting" nails that it takes a little time to develop. Most amateurs make a big ugly hole around the head. Figure 5 shows the proper way to hold the nail set. Steady it with the fingers against the wood so that it will not slip; then make a decisive blow so that the nail goes down below the surface. After that it is easy to drive it as deep as desired without trouble.

In Fig. 6 is shown how to draw pieces into position by the use of nails. The nail is started at an angle from the higher piece, with a crevice left open between the two until the nail has caught the second member. When the nail is driven in, the joint is closed and the lower piece is drawn up into position.

It is well to bore a hole in the end of the hammer handle with a ½-in. auger bit and fill it with soap. After dipping the tip of nails into the soap, the driving becomes much easier.

Unique Triple Stand Combined with an Electric Lamp

THE combination electric light and triple stand illustrated in Fig. 1 is a distinctly novel piece of furniture for the amateur woodworker who wishes to build something that cannot be duplicated in a furniture store. The trays may be used for smokers' articles, books and papers, or sewing materials. The stand would also serve as a corner "whatnot" for the display of curios or art objects, especially as the shelves may be well lighted. As an alternative design, the shelves may be omitted and the top finished as at *A*, Fig. 1.

Mahogany, oak or any wood of medium hardness may be used. The middle post

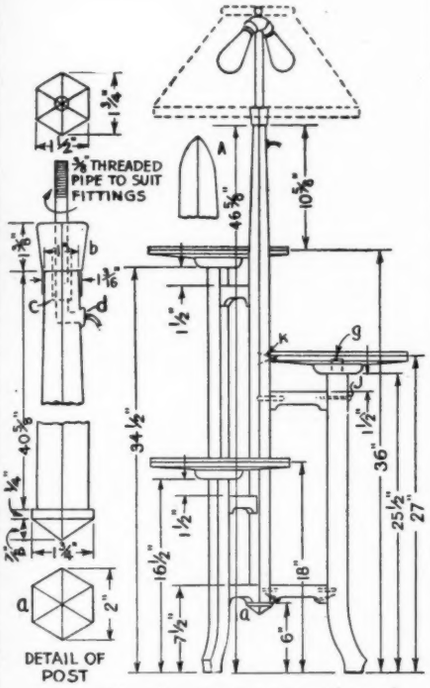
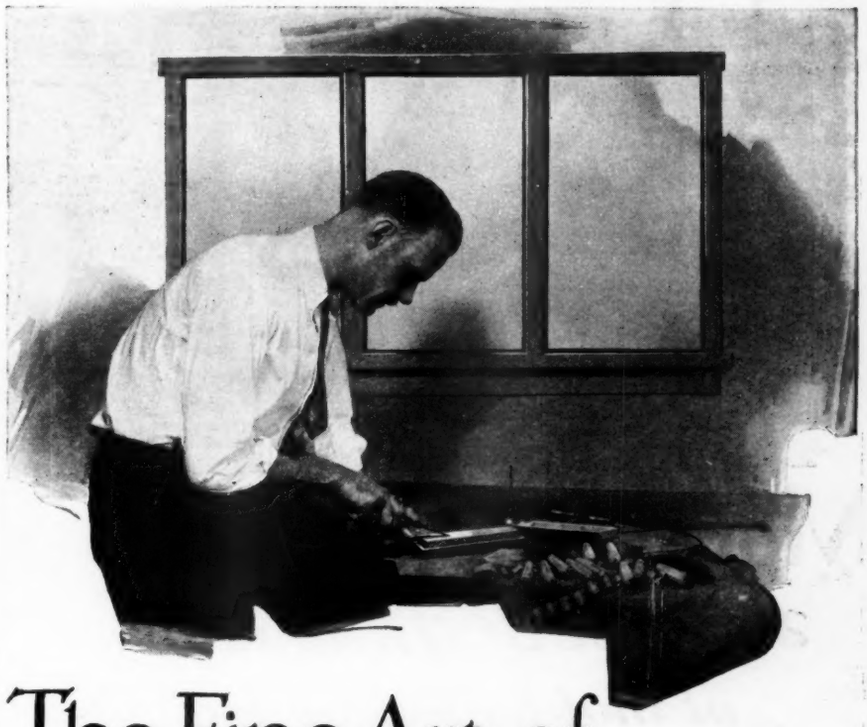


Fig. 1. Side view of the completed stand and a larger detail of the central post.

should be made of a 1¾ by 1¾ in. piece, planed six sided and tapered from the top shelf to 1 in. across the flats at the top.

The pendant base *a* should be six-sided and fastened with brads after the stand has been assembled. The top *b* may be fastened with a ⅝-in. dowel *c* and glue; the ⅜-in. holes to receive the threaded pipe and wire *d* may be bored and the pipe and wire put in after the stand is finished.

Make the three legs for the stands and the six stretchers, and cut the three shelves roughly. Make the lip *e*, Fig. 2, of ¼-in. wood, cut in half circles to the correct size inside and ⅝ in. wide; round the inner edge, smooth and sandpaper the top of the shelf, locate the lip, glue it in place, and work the shelf with the lip down to the desired size. Taper the lower side of each shelf to (*Continued on page 98*)



The Fine Art of Sharpening Edge Tools

HOME CRAFTSMEN have learned a lesson from experienced carpenters and cabinet makers. To keep their tools up to perfection with smooth keen-cutting edges they use and heartily recommend the

Carborundum REG. U. S. PAT. OFF. Combination Stone

—because it is made of Carborundum, the manufactured abrasive—hardest and sharpest.

—because it does "double duty"—coarse side takes out nicks and quickly brings back the edge, while the fine grit side is used for giving the tool edge the finishing touch.

Order from Your Dealer

Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of the Carborundum Company.

Send for Booklet: "How To Sharpen Tools"

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.
CANADIAN CARBORUNDUM CO., LTD.
NIAGARA FALLS, ONT.

Carborundum
REG. U. S. PAT. OFF.
ABRASIVE PRODUCTS

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

More than ocean waves are *needed... to rid him of that half-clean look*

A DASH through the surf, a swim to the raft—even then, she notices, his face still wears that sallow, half-clean look!

For more than ocean waves are needed to make his face really *clean.* Pore-dirt hides in every face.

All day long—on the street, even indoors—the air teems with millions of tiny specks of sooty gray. These specks sneak right *into* the pores—get jammed tight *under* the surface of the skin.

Once under, pore-dirt is there "for keeps" . . . *unless you massage it free.*

That is why Pompeian Massage Cream was made. That is what this cream so clearly *proves* to be true!

Every inch of air, says the U. S. Weather Bureau, is alive with millions of tiny specks of soot. Motor puffs, chimney smoke, dusty streets — no one escapes!

Goes in pink—rolls out GRAY

Below, in the circle, is a photograph taken under the lens of a powerful microscope, showing a section of any ordinary man's skin *after* Pompeian Massage Cream has gone to work!

See the dark marks? They're dried pellets of cream laden with pore-dirt now rolled free! *Now* the skin is *clean*—gloriously clean.

Try it on your own skin! After a hard day's work let this bracing cream bring to your face the freshness of a chap who's just had a few hours' nap. There's nothing like a pick-me-up Pompeian massage to make your friends say, "My, but you sure look well, old man!"

Step out tonight with a face really clean—Pompeian clean! So fresh and ruddy that she will say, "My, but you sure look well tonight! You never looked better in all your life!"

Thousands of men benefit by our FREE offer

Pompeian is 60 cents at any toilet goods counter. You're welcome to test it *free.* Thousands of men have been convinced this way. Please take advantage of the coupon. Mail it . . . *now!*

POMPEIAN MASSAGE CREAM

Dept. 901-I

The Pompeian Company,
595 Fifth Ave., New York.
In Canada: 72 St. Ambroise St., Montreal.

Gentlemen: Please send me a free trial tube of Pompeian Massage Cream . . . enough for two cleansing, invigorating facial massages.

Name_____

Street_____

City_____ State_____

Unique Triple Stand

(*Continued from page 97*)

5/8 in. thickness at the edge, including the lip. Leave the central portion 5/8 in. thick where the 4-in. round block *f* is to be glued.

Bore a 3/4-in. hole to receive the pin *g*, Fig. 1, though two 3/8-in. dowels may be used if preferred, which will allow the top of the leg to be made square.

Note that the screw holes *h*, Fig. 2, of the stretchers are driven slantingly each way to allow a 1 1/4-in. No. 6 screw to be driven easily. Glue each leg with its stretchers to the post. Fit each shelf in place and drive brads through the shelf into the post as at *k*, Fig. 1.

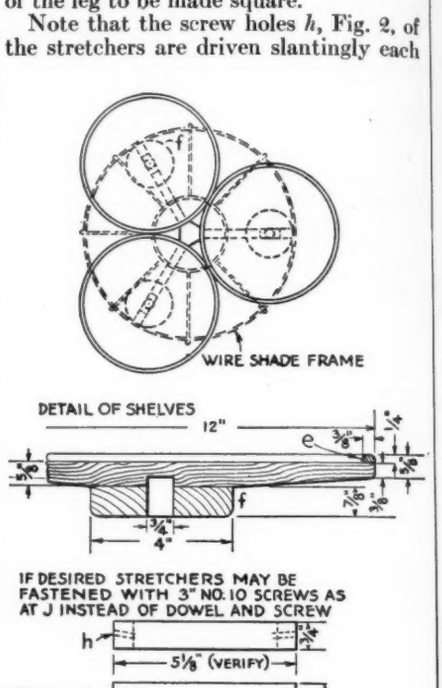

WIRE SHADE FRAME
DETAIL OF SHELVES
12"
4"
IF DESIRED STRETCHERS MAY BE FASTENED WITH 3" NO. 10 SCREWS AS AT J INSTEAD OF DOWEL AND SCREW
5 1/8" (VERIFY)
DETAIL OF STRETCHERS

Fig. 2. Plan view of the stand and the method of constructing the shelves and stretchers.

Sandpaper and prepare the wood for finishing in any desired way. The light fittings may be secured of any electrical supply company. The shade frame may be bought or made of 7/64-in. coppered soft iron wire and covered with silk, parchment or other materials, and the whole supported from the top of the double light socket.—C. A. K.

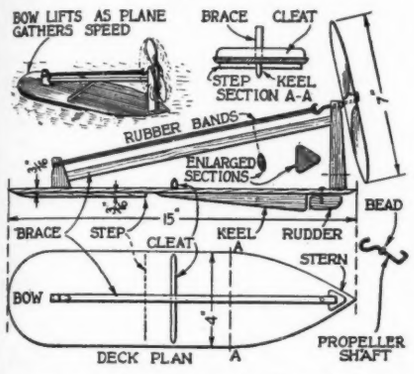
A BADLY misshapen and hardened paint brush may respond to acetone or other cleansing treatment, but usually the result is far from satisfactory. Often badly bent bristles may be remedied, after the paint has been cleaned out, by soaking them in warm water until they become soft and flexible. Brush the moisture out, draw the bristles to the desired shape at the end or edge, and fold stout wrapping paper around them to hold them in place until they have dried thoroughly. Rinse the brush in clean water before using it to remove all traces of soap. If the bristles are still out of shape, repeat the wrapping paper process.

Toy Hydroplane Travels at Great Speed

By Hi Sibley

ITS great power and extreme lightness give this toy hydroplane surprising speed. It is literally a mosquito among water craft.

Use 3/16-in. white cork pine or similar light, soft wood for all parts except the rear propeller support, which is whittled from 3/4-in. stock in triangular cross section, tapered toward the top. Round the edges of hull, keel, rudder and other



How the hydroplane is made. Note the wide step under the forward part of the hull.

parts where streamlining will increase speed. The hull is very thin and will just support the power plant when idle, but under speed the bow will lift.

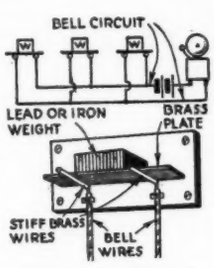
Give the entire craft two or three coats of shellac, well sandpapered, and see that the propeller shaft does not bind. Provision is made for a generous length of strong rubber bands, preferably of the kind sold for model airplanes, so that when well wound the hydroplane will travel for quite a distance.

A somewhat similar toy could be built with the propeller at the bow.

Fire Alarm Rings When Heat Melts Paraffin

IF YOUR home workshop is used by boys who may be careless about fire, or if you have any other reason for installing a fire alarm system, you can do so at a trifling expense.

All you need is a circuit of the type used for house door bells and one or more sensitive fire indicators so placed that they will be affected by any excessive heat. These indicators are merely two contacts, such as a pair of stiff brass wires or nails, bridged by a brass plate, which is held firmly against them by a weight as illustrated. Before being put into position, the brass plates should be dipped in melted paraffin so that they are insulated from the supporting wires or nails. In case of fire the paraffin melts, the circuit is closed and the bell rings.



Wiring diagram and one of the alarms.

WILLIAMS OIL-O-MATIC IS HEATING MORE HOMES THAN ANY OTHER OIL BURNER

WILLIAMS OIL-O-MATIC HEATING

Listed as Standard by the Underwriters' Laboratories

measures *each drop* of its efficient fuel!

EFFICIENCY is never left to chance in the new Model J Williams Oil-O-Matic. Like the carburetor of a fine motor car, Oil-O-Matic's exclusive, patented metering device measures out *each drop* of fuel, and feeds these drops, one by one, into the atomizing chamber.

This is why your Williams Oil-O-Matic *always* burns perfectly, cleanly, without a trace of soot or smoke. Such efficient combustion of heavy fuel oils would be impossible without Williams Oil-O-Matic's exclusive fuel metering and atomization.

Model J Williams Oil-O-Matic is Quieter, Simpler, Handsomer

Thousands upon thousands of Williams Oil-O-Matics have been in continual satisfactory use for years—many more than any other make. Enthusiastic Oil-O-Matic owners have assured us repeatedly that nothing finer could be desired. Yet the new improved Model J Williams Oil-O-Matic *is* more efficient.

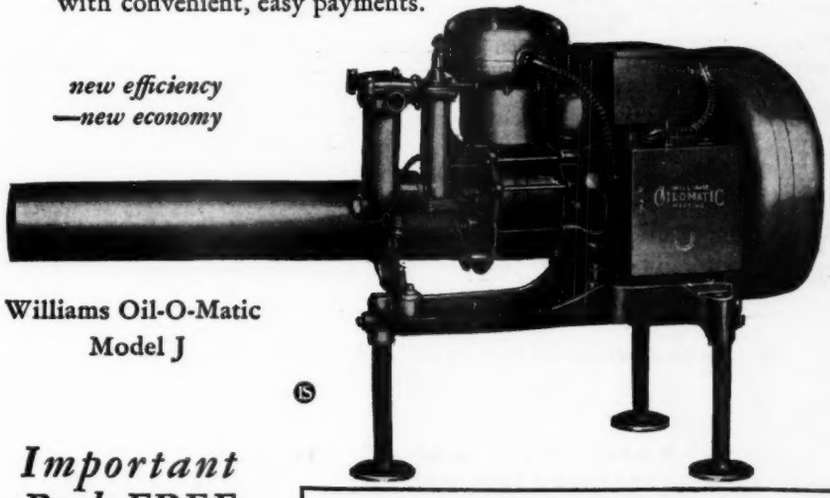
The new improved Model J Williams Oil-O-Matic is quieter, for mechanical noise has been removed—the ball-bearing motor is cushioned in live rubber—parts are machined to the utmost practical limits of accuracy—design has been simplified, making Model J a handsome, efficient heating unit.

Easy for Anyone to Own a Williams Oil-O-Matic

With Williams Oil-O-Matic convenience, with its even, constant temperature, why put up with the work and worry of coal heating? Why not save laundry, cleaning expense, doctor bills, and actual money by buying an Oil-O-Matic *now*.

The cost of Williams Oil-O-Matic Model J is extremely moderate. A small initial payment puts it to work in your home with convenient, easy payments.

new efficiency —new economy



Williams Oil-O-Matic Model J

Important Book FREE

The coupon at right will bring an interesting booklet, "Oil Heating at Its Best." It's free—no obligation. It contains the facts you ought to know before you buy any oil-burner. Clip and mail the coupon NOW.

Williams Oil-O-Matic Heating Corporation P. S. 8-9
Bloomington, Ill.

Please send me your free booklet, "Oil Heating at Its Best."

Name.....

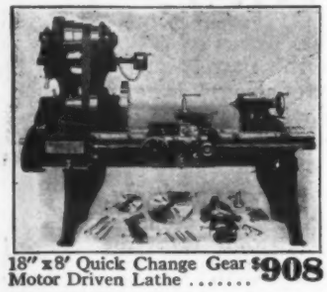
Street and Number.....

City.....*State*.....

SOUTH BEND LATHES

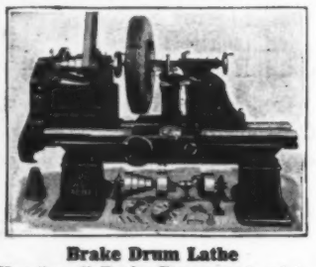
Back Geared Screw Cutting
Precision Lathes
For **Tool Room**
Manufacturing Machine Shop
Repair Shop Service Station

16" x 8' Quick Change Gear Lathe, Straight Bed..... $570

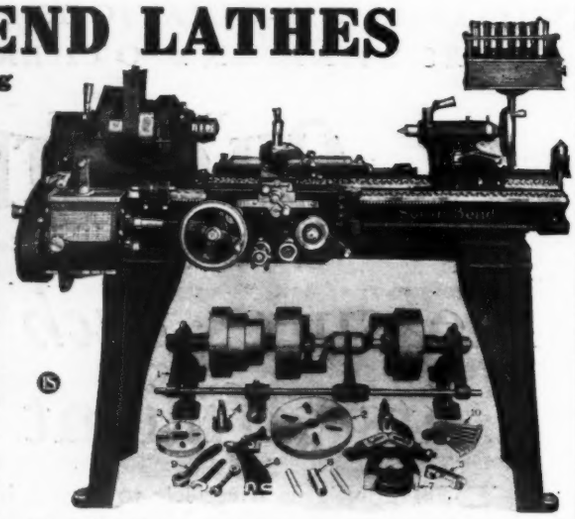


18" x 8' Quick Change Gear Motor Driven Lathe $908

9" x 2½' Junior Back Geared Screw Cutting Bench Lathe. $150



Brake Drum Lathe
Handles all Brake Drum work without removing tire or rim,
No. 1 Lathe, Capacity, 32" Diameter..... $475
No. 2 Lathe, Capacity, 36" Diameter..... $650
No. 3 Lathe, Capacity 42" Diameter Price on Application



11"x4' New Model Precision Tool Room Lathe with Countershaft and Regular Equipment..... $335

Other Popular Selling Sizes

Prices with Countershaft and Equipment

Size of Lathe	Shipping Weight	Standard Change Gear	Quick Change Gear
9"x3'	490 lbs.	$235.	$270.
11"x4'	725 lbs.	$300.	$335.
13"x5'	1110 lbs.	$352.	$402.
15"x6'	1550 lbs.	$430.	$490.
16"x6'	1875 lbs.	$480.	$540.

Easy Payment Plan — 10 Months to Pay

Small down payment, balance in 10 equal monthly payments, or you can purchase through your nearest machinery dealer.

FREE — Catalog No. 89A

describing 210 sizes and types of NEW MODEL South Bend Lathes. Check squares below, indicating lathes in which you are interested.

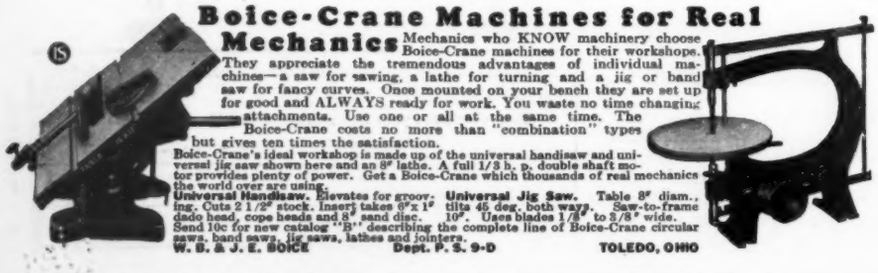
☐ 9" Junior Lathe
☐ 11" Lathe
☐ 13" Lathe
☐ 16" Lathe
☐ 18" Lathe
☐ New General Catalog No. 89A
☐ "How to Run a Lathe," price 25c
☐ Brake Drum Lathe Circular

SOUTH BEND LATHE WORKS
Main Office and Works
850 E. Madison St., South Bend, Ind., U.S.A.

Carried in Stock by Machinery Supply Dealers in Principal Cities Throughout the World

ATLANTA, GA.—Fulton Supply Co., 70 Nelson St.
BALTIMORE, MD.—Carey Mach. & Supply Co., 119 E. Lombard St.
BIRMINGHAM, ALA.—Moore-Handley Hdwe Co.,21st & Ave. "A"
BOSTON, MASS.—Joseph Beal & Co., 455-71 Atlantic Ave.
CHICAGO, ILL.—Scott Barnbach Mach. Co., 130 S. Clinton St.
CINCINNATI, OHIO—The E. A. Kinney Co., 335 Fourth St., W.
CLEVELAND, OHIO—Clark Machinery Co., 1235-45 St. Clair Ave.
DALLAS, TEX.—Huey & Philp Hardware Co., 1029 Elm St.
DENVER, COL.—Hendrie & Bolthoff Supply Co., 1621 17th St.
DETROIT, MICH.—Lee Machinery Co., 6318 E. Jefferson Ave.
HOUSTON, TEX.—Wesendorff, Nelms & Co., 317 Preston Av.
KANSAS CITY, MO.,—H. J. Brunner Mach. Sup. Co., 1512 Grand Av.
LOS ANGELES, CALIF.—Eccles & Davies Mach. Co., 320 S. San Pedro St.
MILWAUKEE, WISC.—Western Iron Stores Co., 145 W. Water St.
NEW ORLEANS, LA.—Oliver H. VanHorn Co, Inc., 522-534 Camp St.
NEW YORK CITY, N.Y.—J. E. Begge Co., 183 Centre Street
OMAHA, NEB.—Interstate Mach. & Supply Co., 1006-10 Douglas St.
PHILADELPHIA, PENN. — Delta Equipment Co., 148 N. Third St.
PITTSBURGH, PENN. — Somers, Fitler & Todd Co., 329 Water St.
PORTLAND, ORE.—The Portland Machinery Co., 62-4-6 First St.
PROVIDENCE, R.I.—The E. A. Eddy Mach. Co., Eddy & Clifford Sts.
ST. LOUIS, MO.—Blackman-Hill & Co., Inc., 1513 N. Broadway
ST. PAUL, MINN.—Robinson-Cary & Sands Co., 4th & Wacouta Sts.
SAN FRANCISCO, CALIF.—C. F. Bulotti Mach. Co., 828 Folsom St.
SEATTLE, WASH. — Perine Machinery Co., Inc , 209 First Ave., S.
TOLEDO, OHIO—The Kirkby Mach. & Supply Co., 20-22 St. Clair St.
MONTREAL, QUE.—Can. Fairbanks-Morse Co., 84 St. Antoine St.
TORONTO, ONT.—A. R. Williams Machinery Co., 66 Front St., W.

A definite program for getting ahead financially will be found on page four of this issue.



Boice-Crane Machines for Real Mechanics

Mechanics who KNOW machinery choose Boice-Crane machines for their workshops. They appreciate the tremendous advantages of individual machines—a saw for sawing, a lathe for turning and a jig or band saw for fancy curves. Once mounted on your bench they are set up for good and ALWAYS ready for work. You waste no time changing attachments. Use one or all at the same time. The Boice-Crane costs no more than "combination" types but gives ten times the satisfaction.

Boice-Crane's ideal workshop is made up of the universal handisaw and universal jig saw shown here and an 8" lathe. A full 1/3 h. p. double shaft motor provides plenty of power. Get a Boice-Crane which thousands of real mechanics the world over are using.

Universal Handisaw. Elevates for grooving. Cuts 2 1/2" stock. Insert takes 6"x 1" dado head, cope heads and 8" sand disc. **Universal Jig Saw.** Table 8" diam., tilts 45 deg. both ways. Saw-to-frame 10". Uses blades 1/8" to 3/8" wide.

Send 10c for new catalog "B" describing the complete line of Boice-Crane circular saws, band saws, jig saws, lathes and jointers.

W. B. & J. E. BOICE Dept. P. S. 9-D TOLEDO, OHIO

Two Tables for the Wood Turner

(*Continued from page 88*)

Fig. 3. Book-trough end table made of maple and stained a rich antique amber color.

If, for the sake of simplicity, it is desired to omit the wing, a table catch may be bought and fastened to the underside of the top in such a way as to lock the top to the upper rail when the top is in the horizontal position.

A line of inlay near the edge of the top and an insert in the center will add to the decorative quality of the table if it is to be stained and varnished. Similarly, an art transfer (decalcomania) can be used in the center of the top if the table is finished with brushing lacquer or enamel. The application of inlays, which is not at all difficult, was described in an article in POPULAR SCIENCE MONTHLY for February, 1927, and the use of transfers in the July, 1927, issue.

The end table, Figs. 3, 4, and 5, requires the turning of four legs. (*Continued on page 101*)

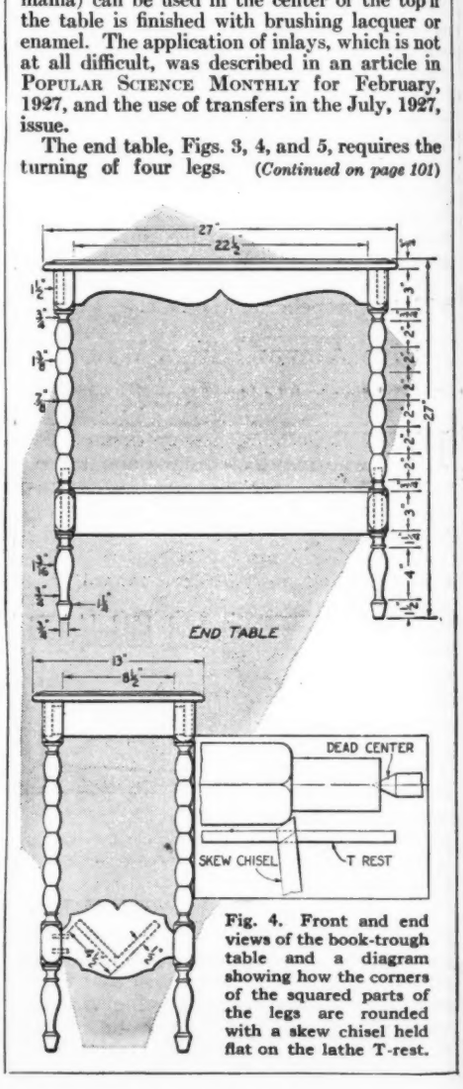


Fig. 4. Front and end views of the book-trough table and a diagram showing how the corners of the squared parts of the legs are rounded with a skew chisel held flat on the lathe T-rest.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Two Tables for the Wood Turner

(Continued from page 100)

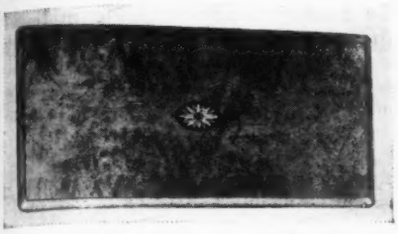


Fig. 5. Looking down on the inlaid top of the end table. The wood is bird's-eye maple.

Care must be taken to have them exactly alike. In making the ornamental book-trough end pieces, it is well to square them and cut the dadoes (grooves) before shaping the edges. Remember to plane and sandpaper the two boards which form the trough before laying out the dadoes into which they are to fit, so as to insure tight, workmanlike joints.

The shaped ends, as well as the upper rails, may be joined to the legs with dowels. Glue up the two ends of the table separately. When the glue is dry, complete the assembly of the framework by joining the two ends, the two long rails, and the two book-trough boards.

The top is fastened by means of cleats about ⅛ in. square, screwed to the inside of the rails flush with their upper edges.

The choice of lumber and of the finish for both these projects is a matter of individual preference. The end table illustrated in Fig. 3 was made of maple and given an amber stain to imitate the color of antique maple. The stain was followed by a thin coat of shellac, which, when dry, was rubbed with No. 00 steel wool. A coat of clear brushing lacquer was next applied, and this was rubbed smooth with powdered pumice stone and crude oil. A coat of liquid wax was finally applied and rubbed to a soft sheen.

The seventh article in Mr. Hjorth's series on wood turning will appear in an early issue.

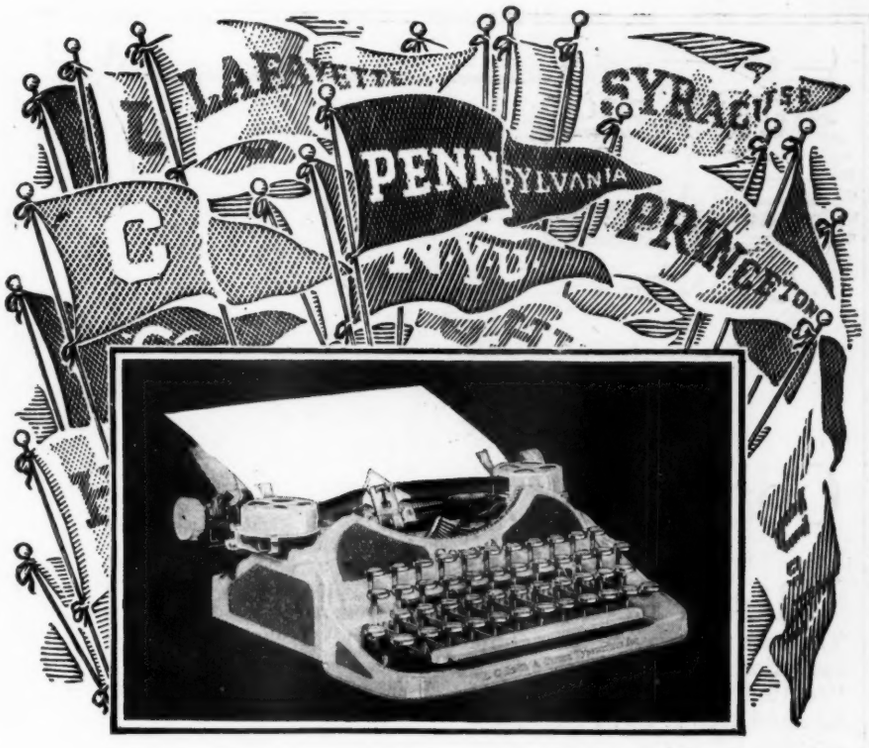
List of Materials

No. Pcs.	T.	W.	L.	Part
				For Occasional Table
2	1½	1½	19⅜	Legs
2	1½	1½	18¼	Stretchers (plain and turned)
2	1½	3	10	Feet
1	½	14	14	Support
1	⅜	25	25	Top
1 pair			2	Fast joint butt hinges
				For End Table
4	1½	1½	26¼	Legs
2	¾	2½	10	Rails
2	¾	2½	24	Rails
1	¾	13	27	Top
2	¾	8½	8	Sidepieces
1	½	4	24	Trough
1	½	4½	24	Trough

All dimensions are in inches.

Shield for Paint Spraying

NOT having a separate room to use when spraying homemade furniture and school projects constructed by boys, I found a good shield could be made from a large discarded window shade. I hung the shade on the wall about six feet from the floor so that it could be pulled down behind the painting table. It is particularly useful when spraying lacquer is being used. When a large shade cannot be obtained, two small ones will serve the same purpose.—GEORGE A. WILSON, Jr.



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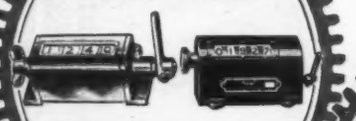

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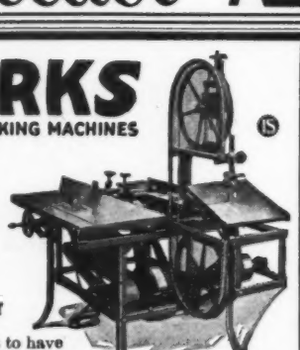

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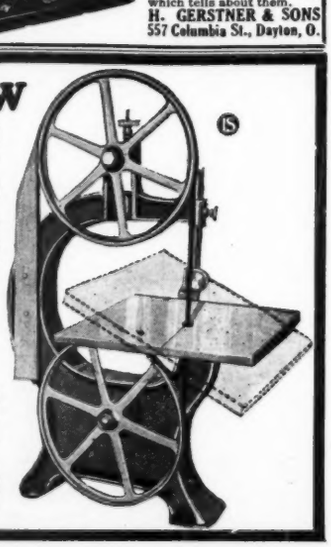

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Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....dollars.....cents

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Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

CHEMISTRY furnishes a cheap and simple means for testing materials. While it is true that the old-fashioned buyer of such raw materials as paints and varnishes, bulk foods, steels and brasses, fuels and cements was satisfied to lay out his money "by guess and by gosh," the hard-boiled modern business man trusts no label but, before spending a nickel, sends a sample from each delivery to a commercial chemist.

Many home workshop chemists do not realize the number of simple chemical tests that they can apply to the numerous materials they themselves buy and so be enabled upon a smaller scale to spend their money as scientifically and economically as the buyer for a big corporation. Amateur chemists are sometimes frightened by the long names, such as "trinitrotoluol," "tetraethyl lead," and "sodium chloride," by which the professional chemist designates the solutions with which he works; but these names usually are worse than the substances.

For example, when a chemist tests distilled water from some drug store, service station, or laundry, to determine its suitability for use in radio or auto batteries, he employs two reagents—ten percent silver nitrate and concentrated thioglycollic acid. Any radio or auto fan can use the same tests. The silver nitrate can be obtained from a drug store. The thioglycollic acid is made by a manufacturer of kodaks and may have to be ordered through a photographic supply house.

TESTING water with silver nitrate shows whether or not it contains sodium chloride or table salt, which is the commonest contaminating element in water. This salt, when introduced into your battery, breaks down into hydrochloric acid, which attacks the plates. To run the test, pour about one quarter of a glass of the water to be tested into a clean jelly glass and then add a few drops of silver nitrate. Stir and look through the water against a black background. In the presence of even a trace of salt, a milky opalescence appears.

Thioglycollic acid is a standard reagent for testing for dissolved iron in water. Iron in battery water probably comes from iron pipes or from poorly tinned containers. In the battery it deposits on the plates and seriously decreases the discharging efficiency. To test for it, thoroughly clean the glass in which you tested for salt, and then pour into it the same amount of the water to be tested as in the previous test. Add one drop of thioglycollic acid and then half a teaspoonful of ordinary household ammonia. In the presence of even a trace of iron in the water, a tint ranging from pink to lavender will develop.—W. H. HAMMOND.

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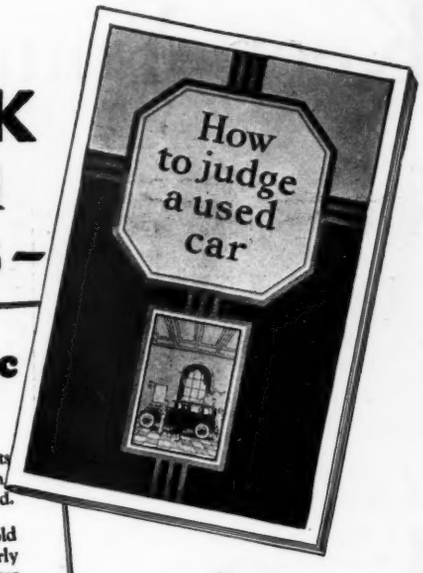

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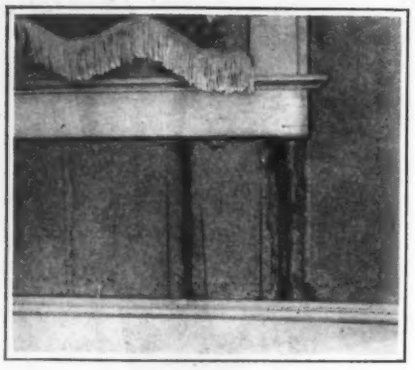


Fig. 1 (at left). Water often leaks in and leaves unsightly discolorations on the walls of a room. Fig. 2 (above). The cause is likely to be a crack between the window sill and the inside stool, which is a molded wood strip resting on the sill.

IT IS easier to build a new house than to keep it looking new. Time and the elements soon produce a subtle change, which advertises its increasing age only too plainly.

Fire excepted, water in the form of rain or melted snow or ice is the most relentless destroying agent. On the outside of the house it streaks the paint and rusts the blind hangers, catches, and other iron hardware and even the flashings, if they are tin. Sometimes the dampness discolors clapboard nails under their coat of paint. It creeps into the house in unexpected ways and soils the plaster and wall paper; it may even warp the flooring.

Next to water, changes in temperature play a large part in aging the appearance of a house, for they produce a continual slow movement of the timbers and all other building materials. Natural shrinkage, too, aids in cracking the plaster, drawing the floor boards away from the baseboards, and causing doors to stick. Constant vigilance on the part of the home owner is necessary to prevent such damage, if possible, and to repair it when it occurs.

It is not, however, the purpose of this article to deal with the obvious requirements—periodical painting, papering, waxing floors, and the like—but rather to point out a few of the obscure and often neglected details.

One of the most difficult places to make water-tight is the joint between the chimney and the roof, particularly at the angles formed by the cricket (Fig. 4), which is the small snow and water deflector behind the chimney. Many building ordinances insist that the chimney must be at least one inch from all "wood or other combustible substances," and this necessitates bridging with metal the gap where it passes through the roof. Copper should be used, but if the house has been built by a speculative contractor, painted flashing tin is probably serving this important purpose. The mere bending of the tin cracks the paint, with the result that rust immediately starts to form. As soon as it is observed, apply paint having a red oxide of iron or a red lead base. Indeed, it is advisable to paint any other exposed tin flashing in roof valleys or around dormer windows in the fall whether it seems to need it or not.

Fig. 3. How a molder's slick is used to smooth and round out patching plaster in a corner.

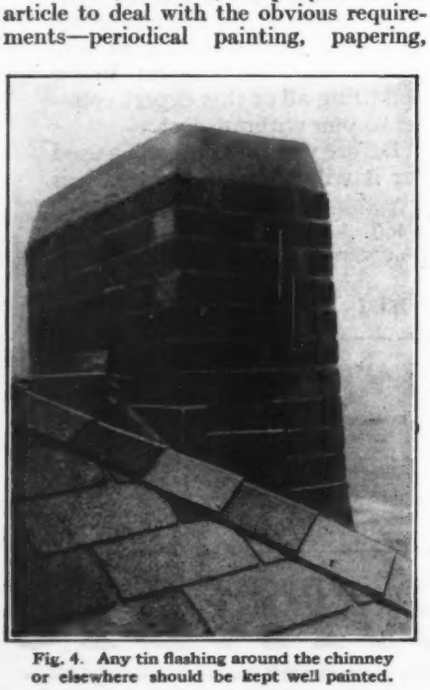


Fig. 4. Any tin flashing around the chimney or elsewhere should be kept well painted.

MANY owners of new homes, after the first heavy rain accompanied by a strong wind, are surprised to find streaks of water running down the wall paper below the window sill (Fig. 1). The exact point of entrance is often hard to locate, but a glance at Fig. 2 will show one inlet to lie between the outer window sill and the inner sill, or window stool. This is because the underside of the inner sill was not painted, and the wood warped or curled upward. A passage from 1/32 to 1/8 in. wide is frequently found between the two sills, and through this the water is driven after passing under the lower sash. The remedy is a heavy coat of white lead followed by two coats of paint. Before painting, some of the unthinned lead should be forced into the opening with a knife to serve as a super-putty.

The cracking of plaster on the walls and ceiling is usually the first evidence that the timbers and siding are drying out and are in motion. Unless metal lath has been used, the worst cracks occur in the corners of the room or around the window and door openings. No other disfigurement produces such an appearance of dilapidation as cracked plaster, and artists seldom picture a home of poverty without including a patch of broken plaster. Usually these cracks are not over 3/16 in. wide and can be obliterated easily. The best way is to cut them out, that is, first make them wider with a tool made from an old file, and then fill them with hard patching plaster, which is obtainable at any hardware or paint store. The smoothing is most easily done with a molder's slick, although a mason's small trowel can be made to serve. The corners can be rounded with the point of the slick as shown in Fig. 3; in fact, it is a good idea to make over all (*Continued on page 105*)

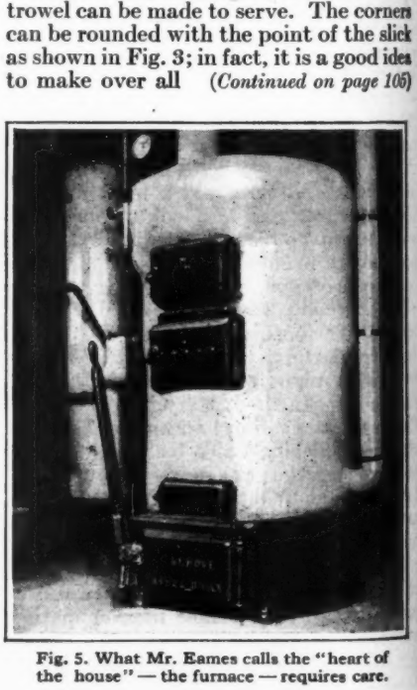


Fig. 5. What Mr. Eames calls the "heart of the house"—the furnace—requires care.

Keep Your House Looking New

(Continued from page 104)

corners in this way on account of the greater ease in cleaning them. Hospitals are always plastered with well rounded corners.

Cracks in papered walls cannot, of course, be filled in until the time comes to repaper, but the damage may be concealed by pasting a strip of wall paper 2 in. wide the full length of the crack.

One other noticeable effect of shrinkage is the gap which appears between the baseboards and the flooring, even when ½-in. quarter-round molding has been used in the angle. The only solution is to remove the small molding in the entire room and substitute ¾- or even 1-in. quarter-round, depending upon the width of the opening to be concealed. The molding should be finished to match the baseboard before being nailed in place. In order to do a good job, the amateur mechanic should use a hand drill to make holes for the brads so as to avoid splitting the molding.

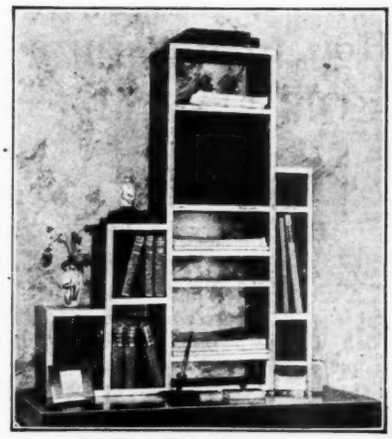
THE heart of the house is in the cellar—the furnace. This important piece of apparatus is seldom properly cared for. Of course, until that millennium comes when all houses are equipped with gas- or oil-fired furnaces, a neat appearing basement will be hard to maintain, but the heater itself should be kept in as nearly perfect condition as possible. If the asbestos covering has become cracked and discolored, it may easily be repaired with asbestos cement. This material, which can be obtained at any hardware or plumbing supply store, requires only the addition of water before being used.

After the cracks and holes have been filled up, the former white appearance of the boiler may be restored with a coat of prepared white water paint or calcimine. Three pounds mixed with boiling water will be found sufficient to refinish the largest heater.

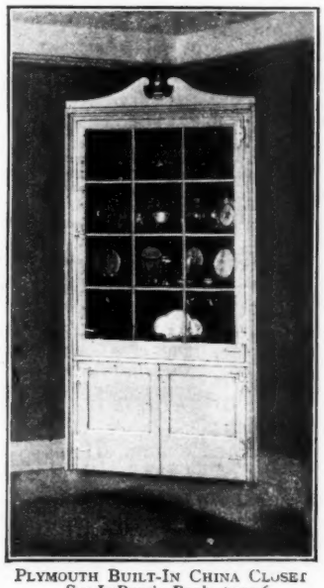
For restoring the discolored or rusted iron parts, a coat of high grade black brushing lacquer makes a lasting finish; it not only retards further rusting, but can be washed free of ashes and dirt without damage.

When the heating system was installed, the asbestos covering on the steam pipes was carefully joined, wrapped with muslin, and sealed with asbestos cement. An inspection of these joints after a year or two may show openings at many of the joints. To repair these, the asbestos cement is resorted to and the joint wrapped with brass binders as shown in Fig. 5. These bands can be obtained from a plumber. They are in reality more decorative than useful, but give the new and finished appearance that every home owner should strive to maintain, even in the cellar.

OLD range boilers, which can be bought at almost any junk yard, make a good culvert for use under a driveway. After the ends have been cut off, the tanks are placed end to end.—W. W. S.



SET-BACK BOOK SHELVES
See LePage's Book, page 9



PLYMOUTH BUILT-IN CHINA CLOSET
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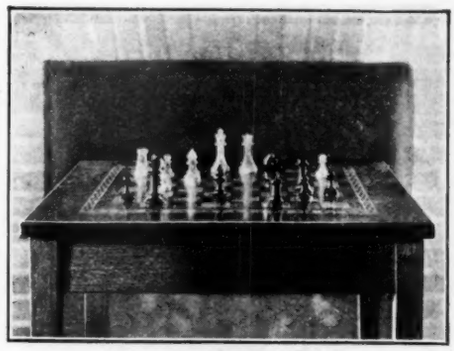

CHESS AND CHECKERS TABLE
See LePage's Book, page 15

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will show you how to make 20 attractive pieces of furniture

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Big Improvement

The first LePage's Home Work Shop Book, two years ago, sold 30,000 copies. Last year the second book sold 55,000 copies. That's popularity for you. An enormous quantity for books of this kind. Now the third new book is better yet. Of its 20 complete projects, 17 are entirely new and never offered before.

Each project is presented in three parts—a photographic illustration of the finished project, a complete dimension drawing of its parts, and simple easy-to-follow, step-by-step directions.

This year the designs are divided into three groups. One group is based on famous old colonial pieces. Another group follows the furniture in popular demand for American homes of today. The third group is known as modernistic furniture, showing the influence of the modern skyscraper set-back architecture of New York City. To buy 20 such pieces would cost about $1000. You can make them for a fraction of that. And yet be the owner of truly fine furniture.

Designed by Expert

All the designs, dimension drawings, actual pieces and photographs were made by William W. Klenke, Instructor in Woodworking, Central Commercial and Manual Training High School, Newark, New Jersey. Also the designer of the first two LePage's Books. Each project and the direction for making it are perfectly practical.

In addition to the three pieces shown above, the book includes the following: *Cape Cod Chest of Drawers, Alexandria Nest of Tables, Old Salem Ship's Cupboard, Lady Washington Sewing Cabinet, Modernistic Desk, Table, Folding Screen and Fire Screen, Smoking Table, Caned Side Chair, China or Book Cabinet, Book Trough and Magazine Stand; Magazine Carrier, Vanity Case, Book Stand, Fernery Stand and Folding Sewing Screen.* Where else could you get complete directions for making all these for only 10 cents?

Send 10 cents for this NEW LePage's Home Work Shop Book

Simply use the coupon below, sending it to us with 10 cents in coin or stamps and we will at once send you a copy of LePage's New Third Home Work Shop Book, postage paid. Address: LePage's Craft League, 608 Essex Ave., Gloucester, Mass. Tear out coupon, so you won't forget it.

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How to Modernize Old Furniture with Paint

By Berton Elliot

IN A great many houses today there is at least one dresser finished in golden oak, which was once universally popular but is now entirely out of style. Perhaps no more profitable opportunity exists for improving home furnishings than by refinishing one of these old-fashioned dressers, together with a couple of chairs and whatever bed is in the room, into a modern bedroom suite. This may be easily done with pleasing colors of lacquer or enamel and the judicious use of art transfers or stencil designs. The cost is slight compared with the transformation wrought or the price of a new suite of furniture.

Fig. 1. A simple form—the trim color follows the top molding and the strips between the drawers.

Often there is an ivory bedstead in the house that can be made the nucleus of an ivory set, or a bedstead in some other color you would like to match in refinishing the dresser and chairs. If some entirely different color scheme is desired, the bedstead may be refinished along with the other pieces at no great cost.

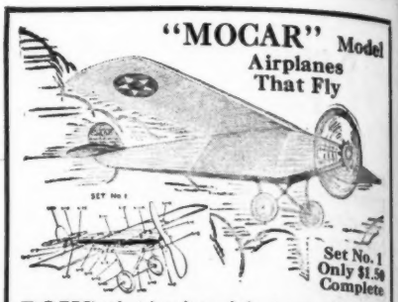
The decoration of painted furniture depends largely upon the design of the piece. The illustrations show several typical methods, which will enable one to work out an appropriate effect. In choosing a color scheme, consider the woodwork and wall decorations of the room, as well as the color preferences of dad, mother, sister or brother, or whoever is going to occupy the room. Ivory trimmed with apricot is an especially pleasing combination. Turquoise blue, jade green, Italian blue, rose and tan are also good trim colors; in fact, almost any color may be used as a trim with ivory. Lettuce green body color, trimmed with cream or gold, is a pleasing and restful color scheme. Two-tone effects are especially good in greens or browns.

Fig. 2. Stippled effects, either pounced or sprayed on, are sometimes used with very good results.

Chinese red trimmed with black, turquoise blue trimmed with ivory, Indian yellow trimmed with black, forest green trimmed with twilight blue, and black trimmed with orange are saucy combinations that will de-

(*Cont. on page 107*)

"MOCAR" Model Airplanes That Fly



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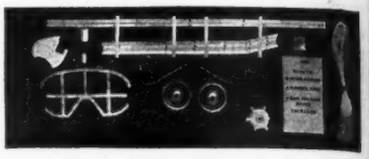
Great fun, learn how to make and fly airplanes. Order now.

Jobbers, dealers and schools write for net prices.

The illustration below shows set mounted complete ready for assembly. Small cut above shows all metal skeleton ready for covering and the large illustration, actual cut of finished plane.



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A definite program for getting ahead financially will be found on page four of this issue.

Ⓢ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Modernizing Old Furniture

(Continued from page 106)

light the heart of the most ardent "flapper."

Powder blue trimmed with ivory and French gray trimmed with white are very dainty combinations. Italian blue trimmed with gold is extremely rich.

With the wide range of colors in which lacquers and enamels may be bought, one will have no trouble in obtaining a harmonizing color scheme; and by tinting

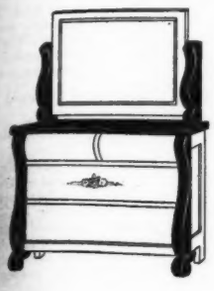


Fig. 3. In some instances it is desirable to use the trim color only on certain portions of the molding.

or intermixing standard colors, one may produce individual effects.

The simplest form of decoration, but an always pleasing one, is where the piece depends for its decorative effect upon a trim color following the molding around the dresser top and between the drawers, as in Fig. 1.

In some cases the design is such that certain lines only of the molding and carvings may be followed with the trim color to bring out a desired effect. Fig. 3 shows a treatment of this kind. The top in this case is a third color.

In Fig. 5 the framework holding the mirror has been cleared away and the mirror hung on the wall above the dresser, a treatment which is distinctly modern. If any screw holes are left in the top of the dresser, they can be filled with a crack-filling preparation, and, when enameled or lacquered over, will not be seen. A panel in the center of each drawer is done in trim color; this is possible with pieces which are designed with raised or sunken panels.

A liberal use of both trim color and art transfers is illustrated in Fig. 4. Trim color may be easily applied by the home decorator, wherever the molding, paneling or framework has a definite edge to follow. Transfer or stencil designs may be placed on all of the drawers, on center drawers only, or on the two bottom drawers only; they may also be placed on the end panels of the dresser, if desired.

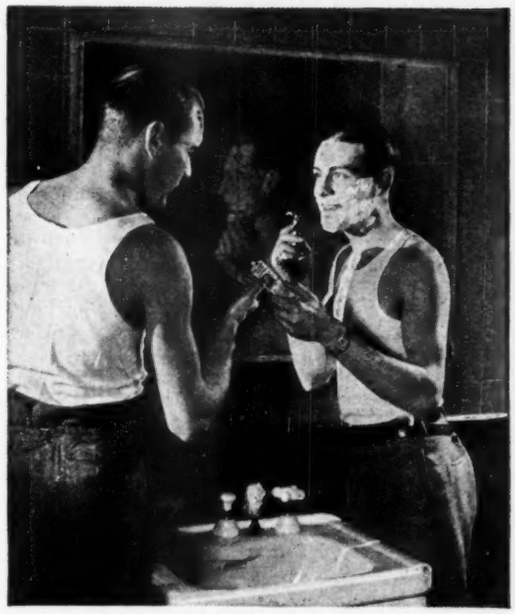
Stippled effects, as shown in Fig. 2, are preferred by many for painted bedroom suites. Stippling may be done by pouncing on the stipple color with a stencil brush or by spraying with an ordinary insecticide sprayer, either mouth type or hand spray type, or with one of the special lacquer sprayers now being sold. However, unless one has had experience in stippling, it is generally better to make use of the plain color trim method when doing larger work such as bedroom furniture, and try out the first job of stippling on some (Continued on page 108)

GONE ..*all* Razor Pull *and* Discomfort

When Beards are Softened Small-Bubble Way

Millions wanted these new shaving results

A faster, smoother shave . . . that's what this offers you. A quick, easy way to get your whiskers off. Without razor-pull, sting or smart. There's a difference in this shaving cream, men, that you can prove by test. See coupon below.

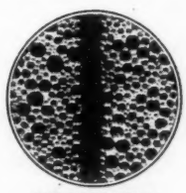


Here's a shave with a smile . . . just try this new small-bubble lather—you'll see the difference.

GOOD news is printed here, for every man who shaves himself. It's the story of a scientific shaving discovery . . . a startling new principle in beard-softening.

The results will surprise you . . . shaving has been made delightfully comfortable. You get a quick, smooth shave . . . every time.

These are results which a test will clearly prove. Clip the coupon if you seek an improvement in shaving methods.



ORDINARY LATHER

Photomicrograph of lather of an ordinary shaving cream surrounding single hair. Large dark spots are air—white areas are water. Note how the large bubbles hold air instead of water against the beard.

COLGATE LATHER

Photomicrograph prepared under identical conditions shows fine, closely knit texture of Colgate's Rapid-Shave Cream lather. Note how the small bubbles hold water instead of air close against the beard.

Small Bubbles the reason

No other shaving cream is like Colgate's . . . a shaving cream based on the now proven principle that water, and not soap, is the real beard-softener.

This small-bubble lather is designed to absorb more water.

That's the principle. Now here's what it does for you:

1. The soap in the lather breaks up the oil film that covers each hair . . . floats it quickly away.

2. Then billions of tiny, moisture-laden bubbles seep down through your beard, crowd around each whisker . . . soak it soft with water. Instantly your beard gets moist and pliable . . . limp and lifeless . . . scientifically softened right at the base.

Thus your whiskers come off clean and smooth. You've never had a shave like this before.

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FREE OFFER, MEN!

Please send me FREE sample of Colgate's Rapid Shave Cream. Also sample Colgate's "After Shave".

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Pipe Smoker Lured By Aroma of Fellow Smoker's Tobacco

Many a man has flirted with the belle of a fancy dress ball, only to find, when the time came to unmask, that he had been attracted by his own wife. The same thing can happen in the case of a man's favorite smoking tobacco. In fact, it *has*. Read the following letter:

Boston, Mass.,
April 21, 1927

Larus & Bro. Co.,
Richmond, Va.

Gentlemen:
This morning I had a smoking adventure worth recording.

Next to me in the smoking car a gentleman was puffing his pipe contentedly. I was not smoking at the moment, and the aroma of his tobacco intrigued me exceedingly. For twelve years I had smoked Edgeworth without being tempted by any other brand, but the fragrance emanating from the pipe of the gentleman beside me was so agreeable that I could not resist the temptation to speak of it.

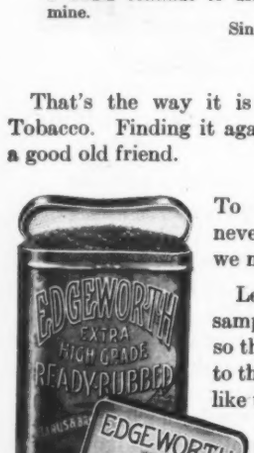
"That is wonderfully fragrant tobacco you have there," I remarked. "Would you mind telling me the name of it?"

"It is Edgeworth," he answered.

We then congratulated each other upon our mutual good taste, and I decided that I would continue to use his brand and mine.

Sincerely yours,
S. H.

That's the way it is with Edgeworth Tobacco. Finding it again is like meeting a good old friend.



To those who have never tried Edgeworth, we make this offer:

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Company, 10 S. 21st Street, Richmond, Va.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

On your radio—tune in on WRVA, Richmond, Va.—the Edgeworth Station. Wave length 254.1 meters. Frequency 1180 kilocycles

Modernizing Old Furniture

(*Continued from page 107*)

Fig. 4. Trim color and art transfer designs can be used in combination to give decorative effects.

smaller piece such as a magazine rack.

Old brass drawer handles may be removed and replaced with modern wooden or glass knobs, which may be obtained at nearly every hardware store.

It is not necessary to take off the old finish in order to do a first class job of refinishing with lacquer or enamel, although for the very finest job possible it should be done.

First, wash the piece thoroughly with soap and water and be sure to rinse off with a copious quantity of clear water. When thoroughly dry, go over the entire surface with a cloth saturated with gasoline, benzine or denatured alcohol to cut away any greasy deposits.

Next, sandpaper lightly—just enough to cut the gloss. Where the previous finish is golden oak, it is better not to sand down thoroughly, especially if refinishing in lacquer. This is because stains are very powerful, and if the protective coatings of varnish and shellac (which seal in the stain) are sandpapered off, the stain may bleed through and discolor the new finishing coats.

If lacquer is to be used in refinishing previously stained woodwork, it is a wise precaution to apply a coat of shellac over the entire surface to seal in the stain more thoroughly, for the high-powered lacquer solvents have a tendency to soften the old finishing coats.

This preparatory work completed, the piece may be lacquered or enameled in the regular way—two or three coats of lacquer applied without sandpapering between coats for a lacquered finish, or, for an enamel finish, two coats of flat undercoater followed by one of enamel (or one coat of half undercoater and half enamel, and one coat of full enamel), in which case one should sandpaper lightly between coats.

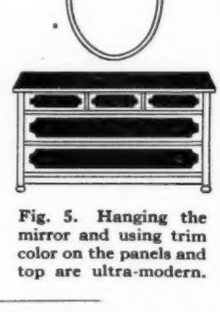
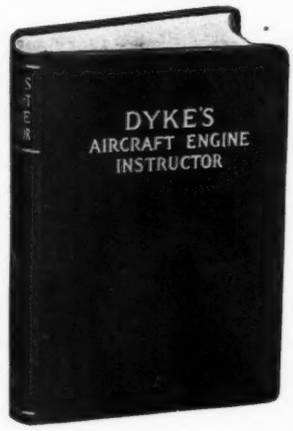


Fig. 5. Hanging the mirror and using trim color on the panels and top are ultra-modern.

THE home worker should discriminate in the grain of the wood he uses. Plain-sawed lumber usually will warp unless fastened securely, yet unless otherwise specified, plain-sawed lumber will be sent if a wide board is ordered. Quarter-sawed lumber will not be likely to warp nearly as much. In ordering lumber for a project always consider this point and insist upon quarter-sawed for every wide piece that is not to be strongly fastened.

Dyke's Aircraft Engine Instructor



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It explains the Wright "Whirlwind" Engine—the "Wasp"—the Curtis—the Fairchild Camines Engine without crankshaft or connecting rods—Inverted Engines which run upside down—the Packard 24-Cylinder Engine and others. Also miscellaneous equipment such as carburetors, magnetos, starters, aeronautic instruments, etc.

Colored Master Charts and many unusual illustrations make very clear the construction of a typical engine. You are shown where troubles are likely to develop and what to do to correct or prevent them.

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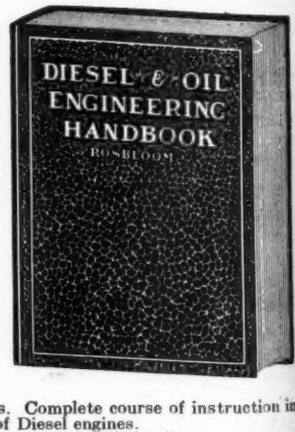
J. ROSBLOOM
Fourth Revised Edition



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Price $5.00—Prepaid.

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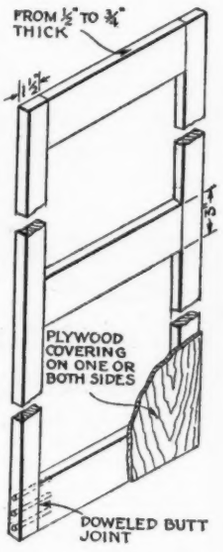
POPULAR SCIENCE MONTHLY
250 Fourth Ave. New York City

Making Modernistic Screens

(Continued from page 59)

smooth. They may be finished with black paint, stain, or lacquer.

If wood is used, it is often desirable to allow the grain to show in at least some parts of the design. The method is to stain the wood as desired, fill the grain, if necessary, and apply a coat of thin shellac. This should be rubbed with No. 00 steel wool or very fine sandpaper. Then the parts in silver, black, or other colors may be applied, as in the case of the fourth screen illustrated. As a very last step in the finishing process, a little furniture wax rubbed on the stained wood will give it a soft sheen. In this, as in all the decorating, avoid crude, glossy effects, but let the colors be brilliant.



One of the simplest ways to make a frame.

In two of the screens shown on Blueprint No. 91, a panel is set within the frame and held in place by narrow strips of wood. The panel is either fiber or wall board and is covered with parchment, which can be obtained in rolls 42 in. wide. Lines to form the design are either painted on the parchment or made with narrow strips of wood, glued or nailed in place.

Three hinges are better than two in joining one screen unit with another. Where the covering is cloth, it may be necessary only to cut the gimp and covering material away at the points where hinges are to be applied. In the majority of cases, however, the wood itself will have to be cut away. Across the edge where the hinge is to be applied, make a recess equal to the length of the hinge and of a depth equal to its thickness. Screen hinges are made in widths to fit frames ¾, 1, and 1½ in. thick.

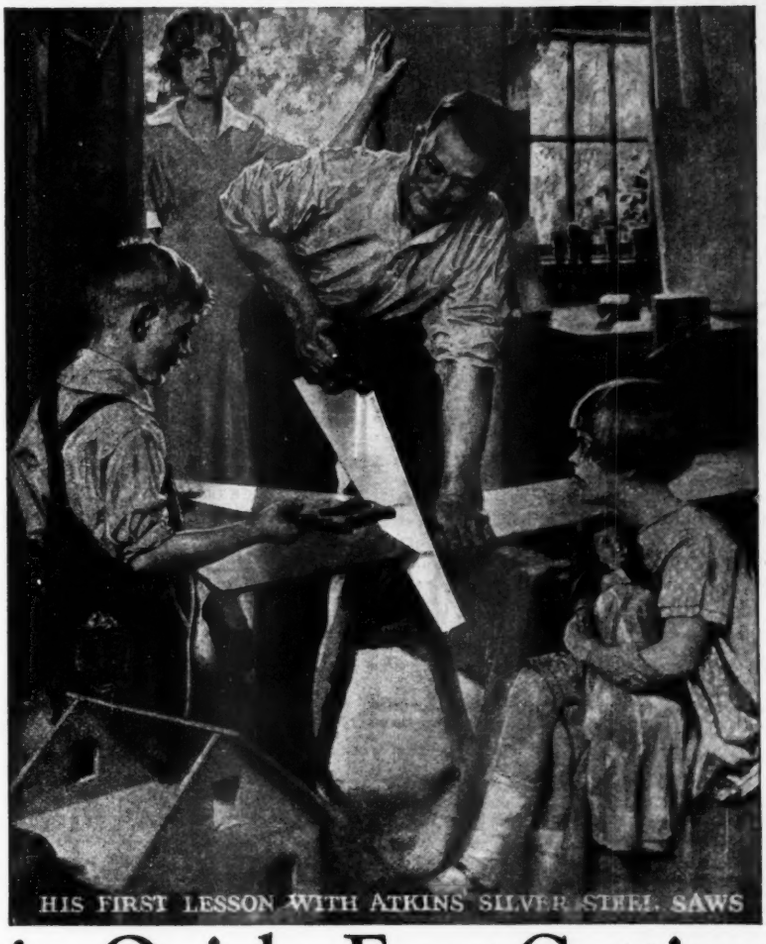
This is the second in a series of articles on a subject that has never been treated heretofore in books or magazines—how to make modernistic furniture at home. The third, which is scheduled for early publication, will describe modernistic lamps.

Giant Model Airplane

(Continued from page 80)

from the nose, to receive the undercarriage. The undercarriage is made of $\frac{3}{16}$ in. diameter reed (rattan). Draw the outline on a board, then drive nails around it to make a form. Soak the reed in water, place it in the form, and dry it in an oven. The reed will then retain its shape. The top ends of the struts are spaced 8 in. apart and hold the axle 11 in. from the fuselage. Bind the top ends of the struts for ¼ in. with silk thread and glue. Make a small hole with a brad ⅝ in. from the end of each strut. The struts are secured to the longerons by forcing a double pointed brad ⅞ in. long halfway into the longerons and forcing the end of the undercarriage struts onto the other end, first gluing the ends of the struts. The joint is completed by passing a piece of 28-gage brass wire through the hole in the strut and then around the longerons. Twist the ends of the wire to fasten them. The front undercarriage struts are located 7 in. from the nose and the rear struts 12 in. from (Continued on page 110)

ATKINS SILVER STEEL SAWS



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Whenever you cut wood or metal, ATKINS "Silver Steel" Saws will help you do the work faster, easier and better. You'll *enjoy* making things for the home and doing jobs around the house, with ATKINS Saws. They will save you time, work and money, and outlast two or three "cheap" saws.

At left is a list of ATKINS Saws and Tools needed in every up-to-date home workshop. Ask your Hardware Dealer about them. Write us for the helpful books on Saws, shown below. FREE—just send the coupon.

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No. 53 Hand Saw . . . No. 53 or No. 51 Rip Saw . . . Coping Saw . . . Compass Saw . . . No. 2 Back Saw . . . Nest of Saws . . . Hack Saw Frame . . . "Silver Steel" Hack Saw Blades . . . Handy Saw . . . Scraper Blades . . . Slim Taper Files. . . Mill B. Files. . . Saw Set.

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The only man who could talk to the Superintendent

"SOON after I began studying," a student wrote to us the other day, "we had a change in management at our plant. I certainly was glad then that I had decided to study in my spare time. For, thanks to my I. C. S. course, I was the only man in the organization who could talk to the Superintendent in his own language. As a result, I was promoted over men who had been here from ten to twenty years. My salary has been increased 90 per cent in the last ten months."

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One hour a day, spent with the I. C. S. in the quiet of your own home, will prepare you for success in the work you like best. *Yes, it will!* Put it up to us to prove it.

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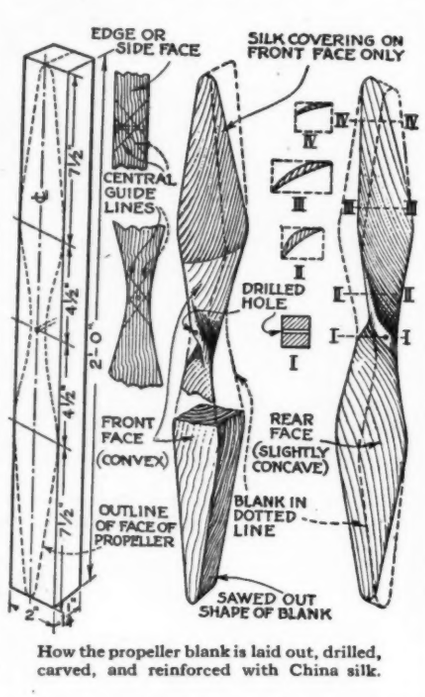
Giant Model Airplane

(*Continued from page 109*)

the nose. Note the upper drawing on page 80.

The wheels, which are made of heavy cardboard, are 4 in. in diameter and 1 in. through the hubs. Cut a disk of cardboard, remove a segment, and force the remaining parts together, thus forming a flat cone. Place two cones together and fasten with glue and wire. Reinforce the hubs with a washer, securing it to the wheel with a small circular piece of adhesive tape. Cover the wheels with silk, gluing it in place with some airplane nitrate dope. The wheels should have hubs for a $\frac{1}{16}$-in. axle—a bicycle spoke 12¼ in. long. Secure them to the axle with a washer and a drop of solder. Bind the axle to the undercarriage struts with four wraps of $\frac{1}{32}$ by $\frac{3}{16}$ in. rubber band. Fasten drift wires of 28-gage brass to the axle between the wheels and the undercarriage struts. Fasten the upper ends of the wires to a screw or brad driven into the nose of the fuselage.

Drill a ⅛ in. diameter hole vertically through the fuselage ¾ in. from the rear end. Cut a piece of bamboo $\frac{3}{32}$ by ⅛ in. by 2 ft. 4½ in.



How the propeller blank is laid out, drilled, carved, and reinforced with China silk.

to form the rudder outline. Glue one end and force it into the vertical hole in the fuselage. Bend the opposite end around it until it parallels the fuselage for ¾ in. and bind in place on the bottom side of the longerons with silk thread and glue. Should it be necessary, the rudder outline may be spliced to make a long enough piece of bamboo.

Cut two pieces of bamboo $\frac{1}{16}$ by ⅛ by 10 in. Bind one to each side of the fuselage at the tail extending backward and upward at an angle of about 45 degrees. These form the rudder ribs. Bind the upper extremity with thread and glue, and force the outline over the ends of the ribs. The rudder spar is white pine $\frac{1}{16}$ by ⅛ in. It is cut to a good force fit. Pass it between the ribs and force the outline over its ends. Cover the rudder on both sides with bamboo paper, gluing the paper to the outline. Leave a ½-in. margin, which can be trimmed off with a razor blade after the glue dries. Give the rudder, entire frame, undercarriage, and wheels one coat of dope.

The stabilizer spar is ⅛ by ¼ by 24 in. white pine. There are 12 ribs, 6 upper and 6 lower. These ribs are not bent, as the stabilizer is nonlifting. The ribs are bamboo $\frac{1}{16}$ by ⅛ by 7 in. The center ribs cross the spar 1 in. each side of the center

(*Continued on page 111*)

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A definite program for getting ahead financially will be found on page four of this issue.

Giant Model Airplane

(Continued from page 110)

line and meet at the center line of the leading edge, which is $\frac{1}{16}$ by $\frac{3}{16}$ by 15 in. white pine. The remaining ribs are spaced 3½ in. apart and cross the spar at the same angle as the center rib. The ribs are secured to the bars by glue and seven wraps of silk thread each way.

The leading edge and the trailing edge (the latter $\frac{1}{16}$ by ⅛ in. white pine) are secured by binding five wraps of thread immediately back of the edges but around the ribs so as to clamp the edging in place. The spar overhangs the end ribs 4 in. The edges overhang the end ribs ½ in. The tip outlines are bamboo $\frac{1}{16}$ by $\frac{1}{16}$ in. The tip is bound to the inner sides of the leading and trailing edges and passed around the end of the spar. It may be necessary to bend the outline pieces slightly. This can be accomplished easily by holding the bamboo over a candle flame and, as it heats, forcing it into the required curve.

The stabilizer is covered on both sides with China silk. Stretch the silk over the frame and brush over the outlines, ribs, and edges with dope. The dope penetrates the silk and causes it to stick firmly to the frame. After it dries in place, trim off the margin with a razor blade and apply one coat of nitrate dope. Brush very lightly, otherwise the top and bottom surface will stick together. Should this happen, they probably can be pulled apart with a needle before they are entirely dry.

THE main wing is of the double surface type. The spars are ⅛ by ⅜ in. by 6 ft. white pine. The wing has a built-in dihedral angle. Mark the center of a spar on one of its ⅜-in. faces; 2 in. to one side mark another vertical line. Draw a diagonal line from the top of one of these lines to the bottom of the other—the diagonal of a rectangle ⅜ by 2 in. Cut along this line, reverse the sides of the cut, and bind the spars together with glue and silk thread to form a splice. Reinforce the splice by gluing and binding with thread on one side a ¼ by 4 in. piece of 30-gage aluminum or light tin. The spars are set on edge, that is, the greatest depth is the vertical measurement.

The ribs are bamboo $\frac{3}{32}$ by ⅛ by 10 in. There are 12 upper and 12 lower ribs. The upper ribs are bent to an even curve by heating them over a candle flame, the highest point of the curve being one third the length of the ribs from the leading edge. The curve is 1 in. high. The lower ribs are bent the same way but should have only a barely perceptible curve.

The center ribs are spaced 2 in. on each side of the center line, and the remaining ribs are spaced at 6-in. intervals, leaving a spar overhang of 4 in. The ribs are secured to the spars by gluing and binding with nine wraps of silk thread each way. The same binding holds both upper and lower ribs. The front spar is located 2 in., and the rear spar 6 in., from the leading edge.

THE leading and trailing edges are of white pine $\frac{1}{16}$ by $\frac{3}{16}$ in. and overhang the end ribs ½ in. The edges are secured by binding and gluing with five wraps of silk thread around the ribs back of the edging, thus clamping the edge in place. The tip outlines are of bamboo $\frac{3}{32}$ by $\frac{3}{32}$ in. They are bound to the inner side of the edges and pass around the spar ends. Should it be necessary, they can be bent by heating over a candle flame.

The trailing edge between the two center ribs is cut away. This allows the wing to rest across the fuselage on its leading edge and rear spar, thereby giving the wing the necessary angle of incidence as the trailing edge drops below the line of the fuselage.

To keep the pull of the covering from distorting the center ribs, it is necessary to install two rib braces of $\frac{3}{32}$ by ⅛ in. bamboo, which run from the tips of (Continued on page 112)

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Giant Model Airplane

(*Continued from page 111*)

the center ribs to the rear spar at the next outboard rib. The braces are secured by being bound in place and glued within the wing. Reinforce the leading edge at the center ribs by binding and gluing to the inner side a piece of bamboo $\frac{1}{16}$ by $\frac{1}{16}$ by $4\frac{1}{2}$ in.

Cover both sides of the main wing with China silk. Stretch the silk over the frame and brush dope along the edges, outlines, and ribs, and the rear spar between the center ribs, thus sticking the covering to the frame. After it dries, trim off the margin of the silk with a razor blade and apply two very light coats of dope. Brush very lightly so the upper and lower surfaces will not stick together. Block the wing in such a way that it will not become distorted while drying.

The propeller is of the "toothpick" type and made of white pine. It is $1\frac{1}{4}$ in. thick at the hub and 2 ft. long. Lay out the block outline as shown on page 110. Draw the outline on a block $1\frac{1}{4}$ by 2 by 24 in. Cut along this outline to form a blank. Drill the hole for the propeller shaft, which is $\frac{1}{16}$ in. in diameter, accurately in the center. Carve the propeller with a sharp knife, the back of the blade being concave and the front convex. The contour of the cross section is such that it resembles a wing curve. After the propeller is carved, it should be carefully finished by sandpapering, and then balanced. To reinforce it, you may cover the blades for about two thirds their length with silk, glued on with dope.

The propeller shaft is $\frac{1}{16}$ in. diameter bicycle spoke wire. Turn one end into a small loop. Force a small staple into the wood at the hub of the propeller, one leg on each side of the center hole. Pass the shaft through the hole, the loop straddling the staple. Sink the loop into the wood at the hub to key the propeller in place. Put four or five copper washers on the shaft and pass the shaft through the bearing. Then turn a hook on the end of the shaft to hold the rubber. The motor consists of about 28 strands of $\frac{1}{32}$ by $\frac{3}{16}$ in. model airplane rubber.

TO FLY the model, mount the main wing and the stabilizer by passing about three loops of $\frac{1}{32}$ by $\frac{3}{16}$ in. rubber over the wing or stabilizer, as the case may be, and tie the ends securely under the fuselage. Adjust the main wing so the model will make an easy glide to the ground. If it shoots up sharply and stalls, slide the wing backward; if it glides heavily, move the wing forward. Wind the propeller until there is a row of knots the entire length of the motor. Holding the model *level* above your head, launch it forward at a good speed with the wind.

If you have followed dimensions carefully and made the frame true, the model will soar away beautifully. A model of this design has flown 1,000 ft. To make a rise-off-ground flight, wind the motor fully 300 turns. Set the model on a smooth surface where it can run 20 ft. with the wind, and it will take off gracefully and fly.

Bamboo, bamboo paper, and bamboo varnish or dope can be obtained at model airplane supply houses.

The work on the propeller can be simplified greatly if one has the blank outline and tapers cut on a band saw at a planing mill. The planing mill can also cut the different sizes of wood accurately on small saws so they will require only a slight sanding to finish the parts.

Always bend bamboo with the glossy side on the outside of the curve. Always apply glue before binding with silk thread.

Remember the axiom: Launch your model in *level* flight.

Whatever type of airplane model you may wish to build, simple or advanced, large or small, you will find suitable designs described in this series of articles and in POPULAR SCIENCE MONTHLY Blueprints Nos. 50, 69, 82, 86, 87, 89, and 90 (see page 102).

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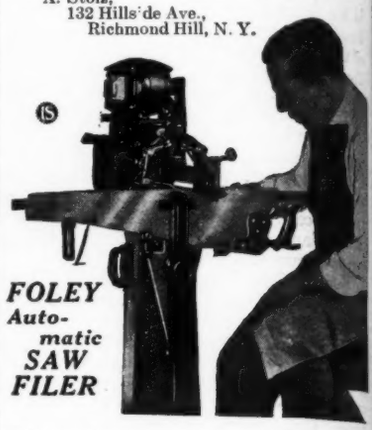

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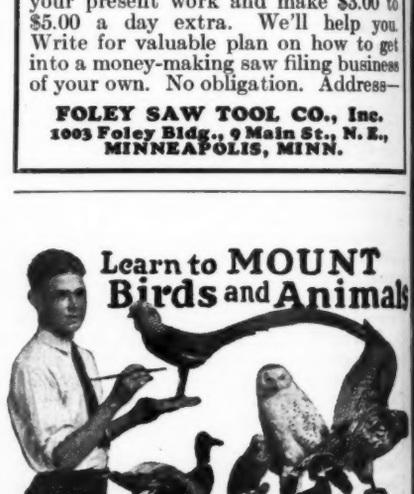

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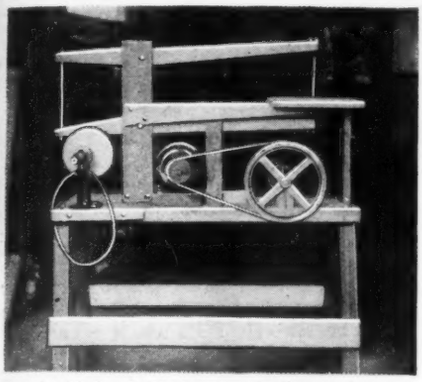
Sturdy Jig Saw Built at Low Cost by Doctor

WHAT can be done at almost no cost at all by an ingenious amateur mechanic is demonstrated by the accompanying illustration of a jig saw built by Dr. L. St. John Hely, of Richmond, Calif.

Wood from packing cases served to make the framework except the legs, which cost 30 cents, and the base, which is a piece of 2 by 12 in. Douglas fir left over from a building operation. The wheel bearing, crank shaft and motor are



The blade of this homemade jig saw is set so that it never jerks the work upward.

from a discarded suction machine of a type used by surgeons for tonsil work.

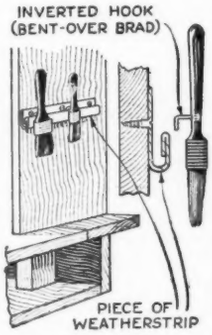
The legs are fastened to the bed by means of ⅜-in. machine bolts; the remainder of the frame is fastened with flat-head wood screws. There is a clearance of 18 in. from saw blade to fulcrum.

A regular jig saw blade, 6½ in. long, is used. It is set in the frame in such a way that it advances toward the work on the down stroke and draws away from the work on the up stroke. Thus it does not tend to lift or jerk the work upward upon the up stroke. Dr. Hely had noticed that many jig saws have a tendency to draw the work up, therefore he designed the arms of his own machine to avoid this.

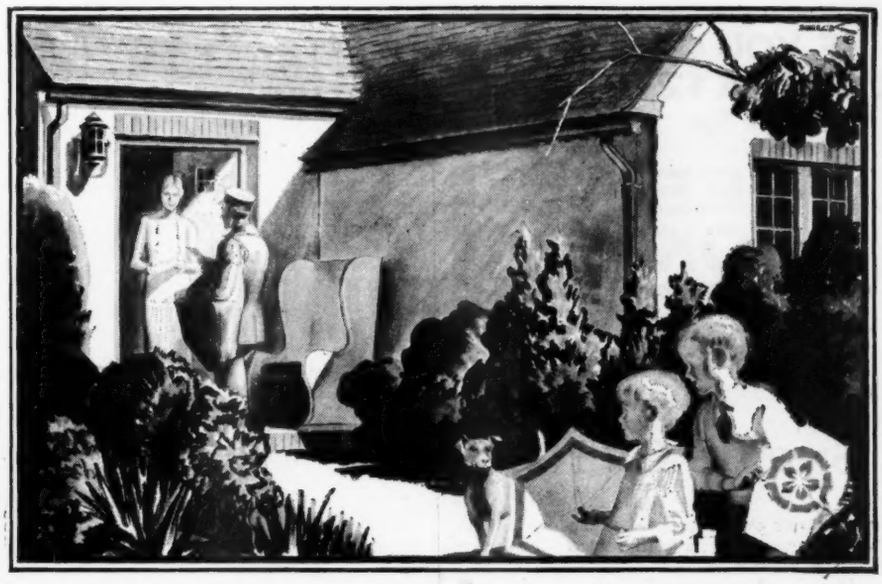
The 1/10-H.P. motor turning at 1,840 revolutions a minute drives the blade at 500 strokes a minute. The stroke is 2½ in., and the machine will cut 3-in. wood.

Neat Rack for Paint Brushes

A GOOD serviceable holder for stain and paint brushes can be fashioned in a few minutes from a piece of metal weatherstrip of the type illustrated. Drill ⅛-in. holes not more than 6 in. apart and fasten any desired length of the strip to the bench or wall with ¾-in. No. 10 round-headed screws. Drive a ¾-in. brad into the base of each brush near the metal butt and bend to a right angle to form an inverted hook for engaging the metal strip. —J. EDWARD BOND.



A paint brush rack made of weatherstrip.



Where the Bell System's profit goes

An Advertisement of the American Telephone and Telegraph Company

THERE is in effect but one profit paid by the Bell Telephone System. This profit is not large, for it is the policy of the Bell System to furnish a constantly improving telephone service at the least cost to the public.

The treasury of the American Telephone and Telegraph Company receives dividends from the stock of the operating companies. It receives a payment from the operating companies for research, engineering and staff work. It receives dividends from the Western Electric Company—makers of supplies for the Bell System—and income from long distance operations.

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How to Whittle a Ship Model

(*Continued from page 60*)

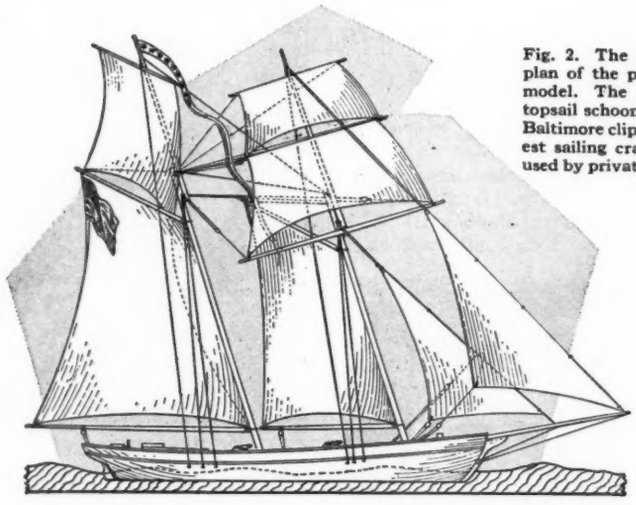

Fig. 2. The sail and rigging plan of the picturesque little model. The rig is that of a topsail schooner. In 1812 the Baltimore clipper was the fastest sailing craft afloat, hence used by privateers and pirates.

Bore 1/8-inch holes for the mast at the positions indicated, noting that they rake a long way aft. Make a 3/32-inch hole in the stem for the bowsprit. Make the masts, booms, lower yard, and bowsprit, tapering them neatly. The lower and topmasts may be in one piece, with holes through the apparent joints for the lower rigging and stays.

The sails (Figs. 1 and 2) are much easier to make than they appear to be. Even-grained soft wood is required (unless you prefer to use linen). For the upper topsail (the highest athwart sail) cut a piece 3/8 inch thick to the outline given, including the yardarm. Along the top scribe two lines to indicate the thickness of the yardarm; along the bottom and sides mark lines to represent the edges of the sail, the bulges, of course, being toward the front. Now whittle the wood on the front until you get nicely rounded curves from the front edge of the yard to the clews (bottom corners). Turn the wood over and whittle away the inside until it is paper-thin at the edges, with just a shade more body in the middle and at the clews. Cut up to the underside of the yard and shape the yard until it is round and of the right size. It is as if the sail were fastened to the top of the yard and hanging in front of it.

THE same method applies to the cutting of all the sails. The edge lines of each are given full size on Blueprint No. 92. The jibs are paper thin at all three edges.

The upper spars (gaffs) are part of the sails in the case of the foresail, mainsail, and gaff topsail. The lower spars (booms), however, are separate pieces because the sails touch them only at the two ends.

The least wood left anywhere, the better; but a little in the belly of the sails will not be apparent, and makes the whole much easier to carve. The forward edges of the fore- and mainsails may have a slight flatness, to allow them to be glued to the masts. (*Continued on page 115*)

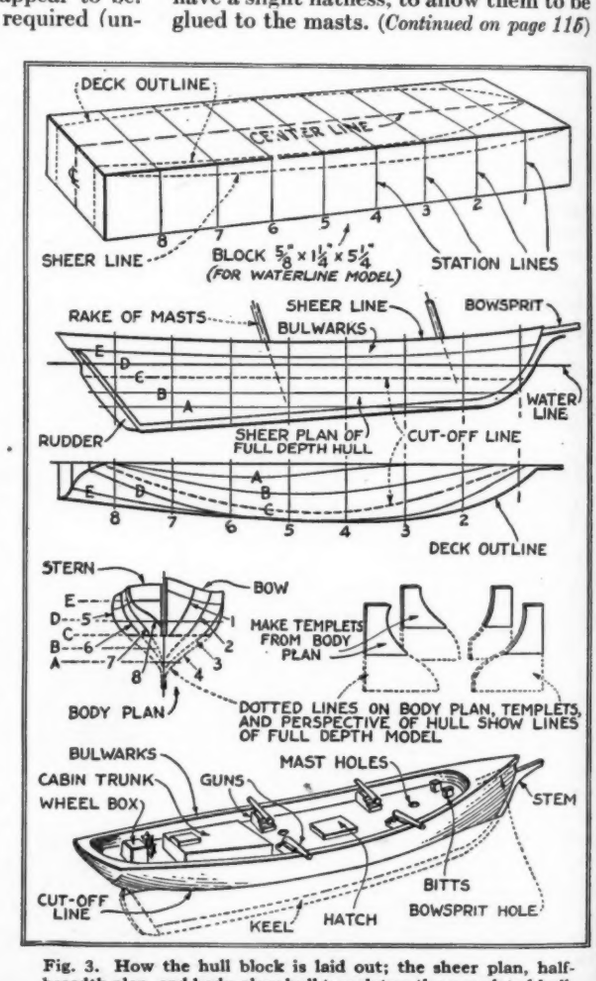

Fig. 3. How the hull block is laid out; the sheer plan, half-breadth plan, and body plan; hull templates; the completed hull.

Whittled Ship Model

(Continued from page 114)

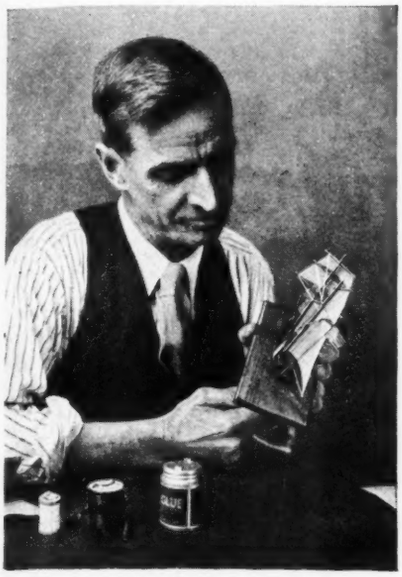

Fig. 4. Captain McCann, who is famous for his ship models, puts the finishing touches on the little privateer. He is driving a screw to fasten base and hull.

The base (Figs. 1 and 4) should be of a size so that no part of the model projects over its edge, with a bit extra abaft; setting the model forward of the middle of the base gives it an apparent forward movement. Presuming that we are going to have the ship leaning from the wind, draw a line on the base about ¼ inch to windward of its center. On this mark the shape of the hull at line *C*, and scoop out a hollow to take the hull, about ¼ inch deep on the leeward side and ⅛ inch deep on the windward. Thus the hull will set in, leaning over. It will be necessary to keep trying the hull in the hole until it fits snugly at the correct angle.

Next the waves must be carved. All the plans given are for the model with the wind supposed to be on the port quarter; the waves will be at right angles to this. There will also be small waves slanting away from the hull on both sides. Waves slope gradually toward the wind and steeply away from it.

ALL IS now ready for rigging the model. The yards may be fastened to the masts with sewing cotton, glue, and small nails or thin wire. I chose the latter as the neatest and firmest. Any very thin wire will do. A thread pulled from plaited, tinned picture wire will answer excellently. Fix the lower yard in position by passing the wire around the mast, taking both ends around the yard, and fastening them behind the mast. The yards will lie horizontally at about the angle shown in Fig. 1.

Fix the lower topsail in the same manner, boring two small holes through the sail close under the yard for the wire to pass through. When the height is just right, the clews will touch the yard below but not overlap. Bore holes in the clews and tie them to the yard below with thin cotton. Fix the upper topsail yard the same way. A touch of glue between the yards and mast will help to keep them rigid.

Next step the mast in position and rig the backstays. These should be of rather heavy black thread that is not hairy. Pass two parts through the hole between the lower and topmasts, bore six holes in the sides of the hull, as shown in the rigging plan (Fig. 2), bring the end of the backstays down to the first two of these, and fasten them there with pegs; draw them tight down (Continued on page 121)

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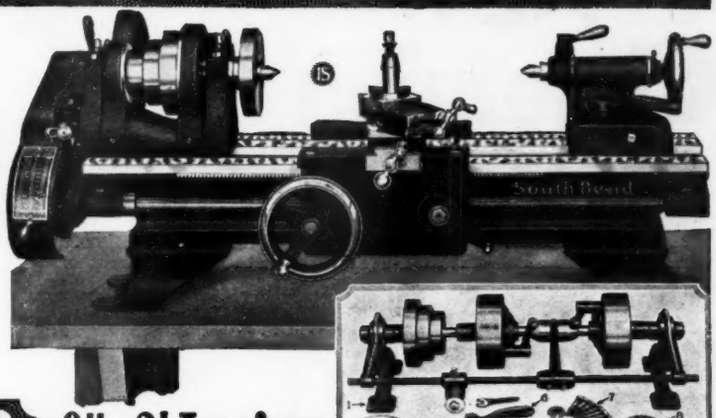

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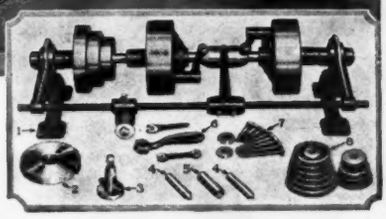

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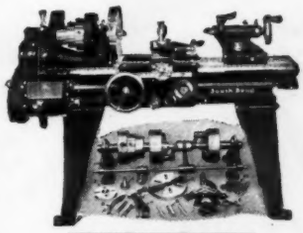

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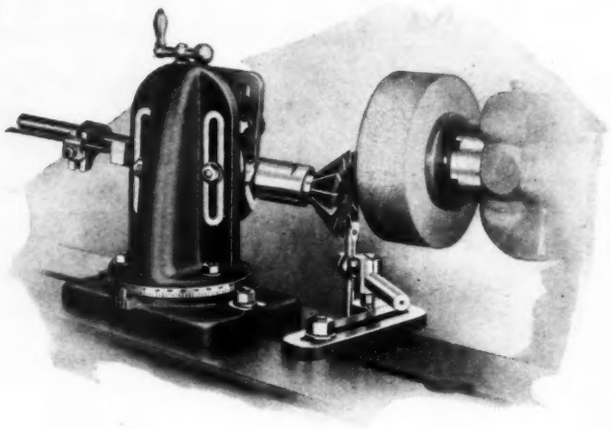


An angular cutter set up for sharpening. The use of a cup wheel has the advantage in many cases of making it easier to grind the clearance at the end where the teeth are very close together.

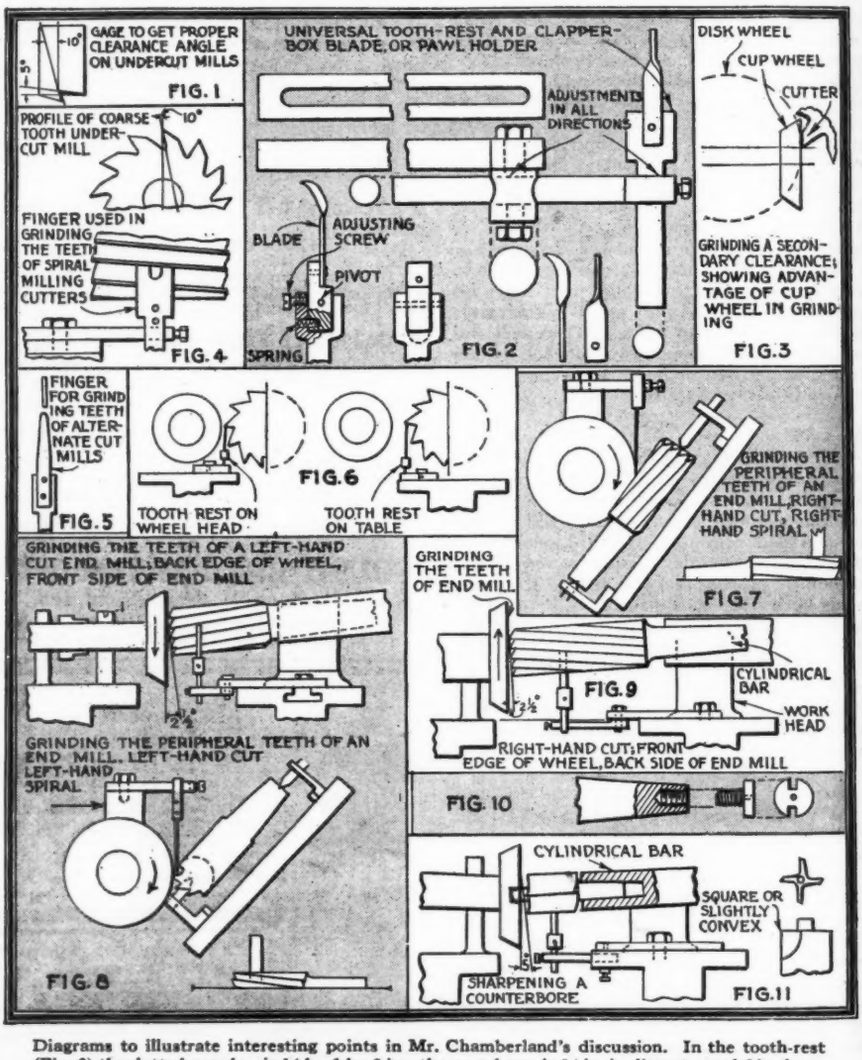
Sharpening Milling Cutters

(*Continued from page 84*)

the cutter and the steepness of the angle must be considered. In many cases the cup wheel is to be preferred.

The side teeth of single angular cutters are ground the same as side mills. For the angular side both cutter and work head have to be reversed, whether the cutter is single or double, right- or left-hand. Some special angular cutters have spiral-cut teeth. To test the angle when grinding these, the quickest method is to use a template. A piece of hardwood 1 in. thick is clamped in the milling machine vise and squared up on one side with a side mill. Then a cut is taken with an angular cutter.

Reamers are ground cylindrically to size and then backed off with a cup wheel. The cutting clearance, also the secondary clearance, should be the same as when the reamer was new.

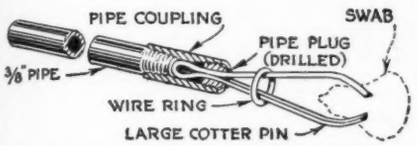

GAGE TO GET PROPER CLEARANCE ANGLE ON UNDERCUT MILLS
FIG. 1
PROFILE OF COARSE TOOTH UNDER-CUT MILL
10°
FINGER USED IN GRINDING THE TEETH OF SPIRAL MILLING CUTTERS
FIG. 4
UNIVERSAL TOOTH-REST AND CLAPPER-BOX BLADE, OR PAWL HOLDER
ADJUSTMENTS IN ALL DIRECTIONS
BLADE
ADJUSTING SCREW
PIVOT
SPRING
FIG. 2
DISK WHEEL
CUP WHEEL
CUTTER
GRINDING A SECONDARY CLEARANCE, SHOWING ADVANTAGE OF CUP WHEEL IN GRINDING
FIG. 3
FINGER FOR GRINDING TEETH OF ALTERNATE CUT MILLS
FIG. 5
FIG. 6
TOOTH REST ON WHEEL HEAD
TOOTH REST ON TABLE
GRINDING THE PERIPHERAL TEETH OF AN END MILL, RIGHT-HAND CUT, RIGHT-HAND SPIRAL
FIG. 7
GRINDING THE TEETH OF A LEFT-HAND CUT END MILL; BACK EDGE OF WHEEL, FRONT SIDE OF END MILL
GRINDING THE TEETH OF END MILL
CYLINDRICAL BAR
FIG. 9
WORK HEAD
RIGHT-HAND CUT; FRONT EDGE OF WHEEL, BACK SIDE OF END MILL
GRINDING THE PERIPHERAL TEETH OF AN END MILL. LEFT-HAND CUT LEFT-HAND SPIRAL
FIG. 8
FIG. 10
CYLINDRICAL BAR
SQUARE OR SLIGHTLY CONVEX
SHARPENING A COUNTERBORE
FIG. 11

Diagrams to illustrate interesting points in Mr. Chamberland's discussion. In the tooth-rest (Fig. 2) the slotted member is 5/8 by 1 by 9 in.; the round arm is 5/8 in. in diameter and 6 in. long.

Handle for Swab Rag

CLEANING out the inside of a pipe, hollow casting, or any deep hole or receptacle is often difficult to do satisfactorily. The usual expedient is to tie a rag to a stick or piece of wire, with the result that either the rag pulls off or else fails to reach the bottom corners.

The device illustrated is easily made and overcomes these difficulties to a great extent.



A simple cleaning device for reaching into the inside of a pipe, hollow casting, or deep hole.

The materials are: a piece of pipe about 30 in. long or to suit the depth of the hole, a pipe coupling and plug, a large cotter pin, and a small ring or piece of wire bent into a ring.

The plug is drilled with a hole just large enough to allow the cotter pin to pass through up to the eye. When the pipe and plug are screwed into the coupling, the eye of the cotter pin will be gripped between them so that it cannot twist or wobble. A rag stuffed between the bent legs of the cotter pin will "stay put" but can be quickly changed when necessary. The use of the slip ring to hold the legs together is optional.—HARRISON L. KETCHAM.

Two Aids in Lathe Work

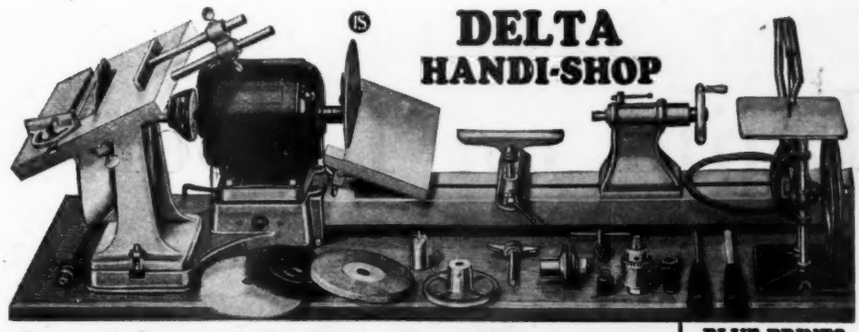
(*Continued from page 86*)

a lathe. Many a job that cannot be handled otherwise, except with difficulty, is rendered a simple task by the use of the long center.

A convenient length to make the center is to have the body equal to about the greatest distance the tailstock spindle can be safely let out. In Fig. 2 a plain shaft is shown being ground, and it will be seen that the wheel is inclined at very nearly the greatest angle to the work that it should be for good results. Figure 3 shows the difference in the angle made when using a regulation tail center; the grinder must be tipped at about double the angle. While it is true that work can be, and sometimes is, so done, it is equally certain that this is not the way it should be done. Besides, if inclined too far the wheel is apt to interfere with the faceplate even if it does not with the dog. That would be the case in this example if the special lathe dog described in the October, 1927, number of POPULAR SCIENCE MONTHLY were not used.

Another example, even more to the point, is given in Fig. 4. Here a form tool, placed on a regular arbor made for the purpose, is shown being finished on a long tapered surface adjoining a straight shoulder, which in the tool will be slightly undercut for clearance. The way to handle such a job on the lathe is to set the grinder either parallel to the lathe spindle; or, better, slightly tipped outward, so that by advancing the compound rest the wheel can be drawn along the entire tapered surface right into the corner. With the long center, this can be easily done, but the dotted line shows that it would be impossible with the regular center. Even with the tailstock spindle extended to the very limit, the wheel would be bound to strike the flange long before it reached the corner. The unsatisfactory makeshift of having to divide the cut into two operations, performed at two settings of the grinder, would have to be resorted to before the job could be finished—an expedient that is the more troublesome the finer the work is required to be.

It might be feared that the long center, because of its slenderness, would cause trouble through vibration. As a matter of fact, lighter cuts must be taken.—HENRY SIMON.



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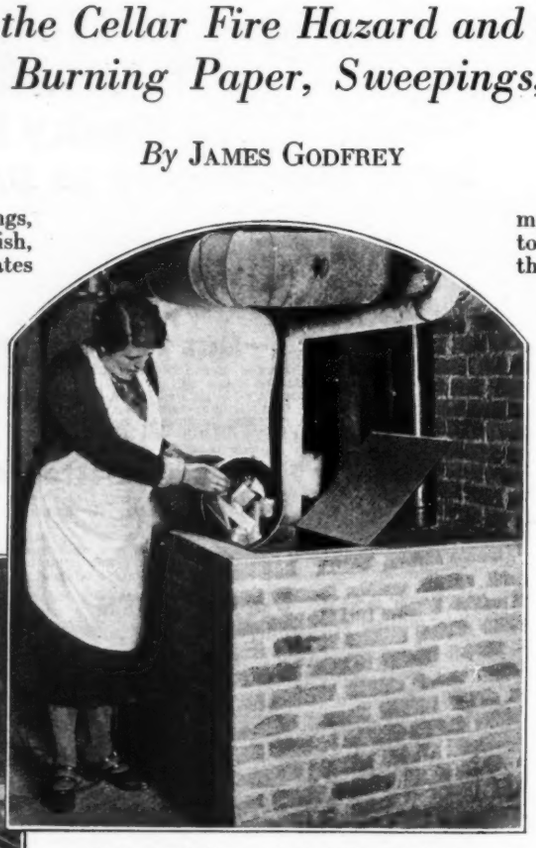
By DOING a Little Amateur Bricklaying, YOU CAN

Build *an* Indoor Incinerator

It Reduces the Cellar Fire Hazard and Saves Much Trouble in Burning Paper, Sweepings, and Trash

By JAMES GODFREY

DISPOSING of paper, sweepings, and other combustible rubbish, which constantly accumulates in every home, is an endless task. Worse still, their storage while awaiting disposal creates a serious fire hazard. To burn the rubbish in the furnace quickly chokes the pipes, ruins the fire in winter, and heats the house in summer. If the house is equipped with an oil burner, the accumulated trash must be burnt out of doors where it may annoy the neighbors and possibly endanger surrounding property from flying sparks.



All the combustible waste of the household can be burned safely in this type of incinerator.

Mr. Eames shows how the brick walls are laid up after the flat grate bars are in place.

A simple solution of the problem is to build a brick incinerator in the cellar and keep the trash fires indoors where they belong. It is not necessary to be a mason to accomplish the feat; anyone can construct an incinerator like that illustrated. The principal materials required are a bag of Portland cement, 15 lbs. of unslaked lime, about 150 common brick, a clean-out door, and a few other metal parts to be mentioned later.

A cement base is first laid, followed by three courses of brick. On top of the third course a grate is formed of metal strips; then the walls are built to the desired height. The top is then put on and a connection made to the chimney.

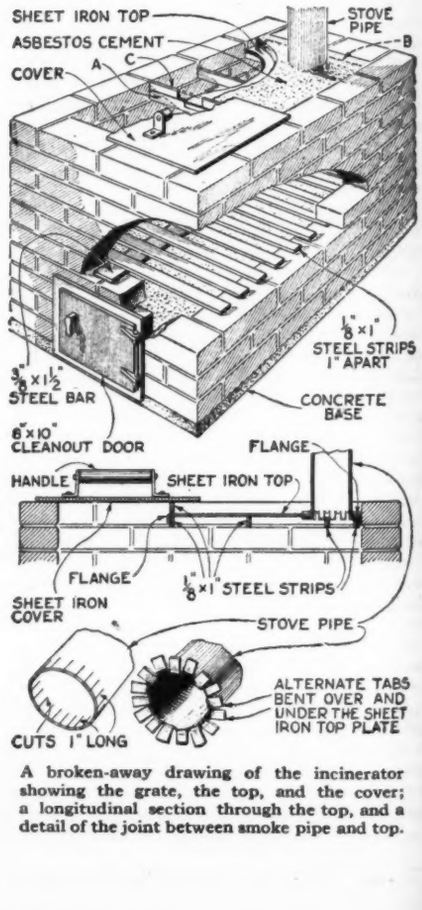
The incinerator shown has a capacity of about a barrel and a half of loose papers, but the dimensions may be varied, of course, to suit conditions. If the base of a fireplace chimney or a large main chimney is accessible, it may be used as one wall of the incinerator.

The base should be made of one part of cement to three parts of sand. Its thickness should equal or exceed the overhanging flange of the clean-out door. An 8 by 10 in. door is recommended; it may be obtained at any large hardware store. When the base has set sufficiently, place the door in position by stacking bricks in front and in back of it. Next lay up three courses of brick. Break the joints and use a ⅜-in. layer of mortar. The top of the third course will come about level with the top inner flange of the clean-out door.

A strong, easily handled mortar is made as follows: To one bucket of sand sifted through fly screening add one quarter bucket of slaked lime and one third bucket cement, mixed in the dry state. This amount of lime should give the mortar a clinging quality not possessed by an ordinary cement, sand, and water mixture. To slake the lime, place the lumps loosely in a pan or a wooden box and slowly pour on water until the bubbling and steaming cease. The heat produced should dry out the lime quickly to a powdery state unless too much water has been added. If it remains in a smooth, pasty condition, it requires more mixing and should not be added to the sand, cement, and water until they have been mixed. Be careful not to touch the lime while it is slaking, as it is much hotter than boiling water; and do not try to mix the mortar in a pail, but use a mixing board or the concrete floor of the cellar. About two buckets of mortar should be sufficient for three courses of brick.

The grate should be built up of ⅛ by 1 in. steel strips laid 1 in. apart and supported down the middle with a ⅜ by 1½ in. steel bar, one end of which rests against the inside edge of the door and the other on the rear brick wall. If the steel strips do not lie flat on the side walls, bend them slightly in the middle so that they will just clear the middle support. They will settle into position later. About 17 lbs. (40 ft.) of 1-in. strips will be required for this, but 20 lbs. should be bought as a few strips are required to support the top.

(*Continued on page 119*)



A broken-away drawing of the incinerator showing the grate, the top, and the cover; a longitudinal section through the top, and a detail of the joint between smoke pipe and top.

Indoor Incinerator

(*Continued from page 118*)

Continue the bricklaying until the desired height is reached—a total of from ten to twelve courses. Point up the mortar with a rounded stick after it has set for about an hour. In order to make a true and square job, a carpenter's level should be employed unless the base of a chimney is being used as a starting point, in which case a straightedge will do.

Place steel strips edgewise between the joints of the brick to support the top, which is a piece of heavy galvanized sheet iron with a hole cut out with a cold chisel for the smoke pipe. A short piece of ordinary stovepipe should be attached to the opening thus made. This can be accomplished by using a pair of tin snips to make a number of cuts 1 in. long and approximately ¾ in. apart around one end of the pipe. Alternate tabs should be bent outward at right angles and the end of the pipe thus "fringed" thrust through the opening in the galvanized sheet. The tabs which pass through should be bent outward at right angles on the underside and both sets hammered tight so that the pipe is held rigidly.

If the smoke pipe is joined to the heater pipe, an opening for it may be cut with a cold chisel, provided a piece of cordwood or any other heavy object is thrust into the pipe to cut against. It is not necessary to cut an accurate hole, as the joint can be sealed easily enough with asbestos cement. The top from *A* to *B* is covered with asbestos cement.

All that remains is to make a cover for the opening into which the rubbish is to be dumped. This is a piece of sheet steel ⅛ in. thick to which is attached a handle. If a hinged cover is preferred, the steel strip marked *C* should be drilled for rivets and hinged to the cover before it is set in the mortar.

Shavings Used to Imitate Difficult Inlaid Work

IMITATION inlaid inserts or marquetry ornaments can be made from shavings in a fraction of the time required to cut and apply real inlays.

With a very sharp finely set plane, prepare a few wide, thin shavings of the wood or woods to be used in the "inlay." Choose woods that will contrast with the surface to be inlaid.

Cut the desired design from the shavings with a pair of sharp scissors and use manicure scissors, if necessary, for any very intricate curves. Apply liquid glue to the spot where the inlay is to be placed on the piece of furniture or other work to be ornamented, and allow it to become tacky. Then press the prepared shavings carefully in place and wash off any surplus glue. With a rolling-pin or any convenient roller, flatten the shavings into the wood as far as possible. In soft wood they will sink flush with the surface.

When the glue is thoroughly dry, the finish may be applied. Preferably this should consist of one coat of thin shellac and several coats of varnish. Each intermediate coat should be rubbed with very fine sandpaper, and the final coat with powdered pumice stone and oil.

With a little practice anyone can obtain admirable results by this method. If it is desired to use some color in the "inlays," a few shavings should be dyed beforehand with wood stains or household dyes.—L. T. G.

COPING and fret blades and still finer jewelers' saws are likely to become rusty when kept in a cellar workshop or in any place where they are exposed to dampness. To make a rust and acid proof case for these blades, obtain a piece of glass tube of suitable size, seal one end over a Bunsen flame, and cork the opening.—G. O. L.

SIMONDS

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Give him Simonds Planer Knives and watch production speed up. Simonds cutting edges are made of the finest scientifically treated steel and backed by three-quarters of a century's experience in the manufacture of cutting edges that cut costs and lengthen profits. Specify Simonds for economy!

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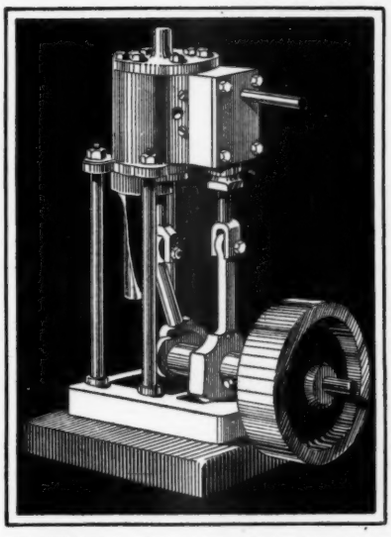

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"Model Making," by R. F. Yates, describes the construction of model gas-engines, steam-engines, locomotives, boats, dynamos, turbines, railroads, guns, etc. Thirty chapters are devoted to models of various nature.

It will help you to become a better mechanic. It will help you to do hard soldering, soft soldering, lathe work, tempering, drilling, pattern-making, etc.

This is a book every amateur or professional mechanic and model maker should have.

"Model Making" describes real engineering models, not toys. 432 Pages, 350 Illustrations. Practical, complete, easily understood. Price Postpaid, $3.00.

POPULAR SCIENCE MONTHLY
250 FOURTH AVENUE, NEW YORK

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10,000 Practical Formulas—The Best Way to Make Everything

A book to which you may turn with confidence that you will find what you are looking for. A mine of information, up-to-date in every respect. Contains an immense number of formulas that every one ought to have, that are not found in any other work.

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Burgess "Super B" Batteries have larger cells than standard batteries. Extra power and life are thus provided. Uniformity is insured by scientific precision in manufacture. Radio's cost is lowered appreciably by the use of "Super B" No. 22308, a medium size heavy-duty 45-volt battery, designed for general, all around use . . . or "Super B" No. 21308, the largest size Burgess heavy-duty 45-volt battery, made especially for heavy-current consuming sets.

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BURGESS BATTERY COMPANY
General Sales Offices: CHICAGO
In Canada: Niagara Falls *and* Winnipeg

BURGESS "SUPER B" BATTERIES

Outboard Racing Secrets

(*Continued from page 93*)

deal like buying an automobile They are all good, but some have been developed for special requirements.

For the racing enthusiast it is doubtful if any hull will fill his needs so well and help him to win as some of the single-step hydroplanes. For the more conservative, those who are satisfied with twelve to sixteen or eighteen miles an hour, there are several round and V-bottom boats that will carry a good load and still give one a thrill, because sixteen or eighteen miles an hour is chasing right along when you are only a few inches from the surface of the water. From my own experience, I find more of a thrill in a high-speed small boat than I do in an airplane, and I attribute the feeling entirely to the fact that I am gliding over the water surface and have stationary objects on shore near enough to give me relative values.

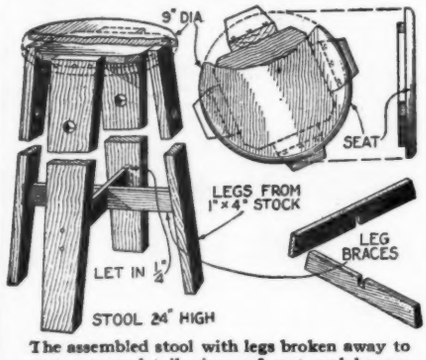
If one wants carrying capacity for short jaunts, such as picnics, there is probably no hull better suited to all-around use than one of the outboard sea sled type. With a Class-B motor it will shove along at twenty miles an hour or better. Then there is the old standby, the flat-bottom boat, which, since the advent of the outboard motor, has been glorified to an almost unbelievable extent. For those who must have extreme lightness for portability, there is the square-stern canoe, which is a very speedy craft with comparatively low power.

Whatever the type of boat, best results may be expected only if some care is given to the motor. Keep the upper parts dry and clean. See that it has oil at all times. Do not turn it upside down, for there is a chance that water will get into the cylinders. Be sure to fasten it tightly to the stern of the boat; many an outboard motor rests peacefully in Davy Jones's locker.

The modern outboard motor is practically free from vibration. Given ordinary care, it will give its owner more pleasure than any other piece of mechanism devoted to sport. And it will last many years.

Quickly Made Kitchen Stool

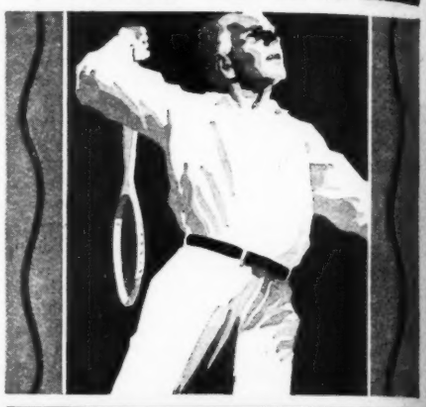
HOW a strong yet slender kitchen stool can be made in an hour or so with the simplest of tools is shown below. Two pieces of wood (from packing boxes) are used for the seat, the grain of one piece crossing that of the other for strength. The upper piece is round or octagonal; the under one is square and to it are nailed the legs, which are made



The assembled stool with legs broken away to save space; detail views of seat and braces.

from 1 by 4 in. "trim"—smoothly finished boards of good quality—measuring about ¾ by 3½ in. in actual cross section. The legs are tapered down to the bottom and their top and bottom edges sawed at an angle to allow for the slight widening of the stool from top to bottom. The leg braces of 1 by 2 in. stock are fitted as shown. Although not essential, gluing the joints will strengthen the stool. It should be painted to match the kitchen color scheme.—ERIC B. ROBERTS.

For safety in Exercise
Wear a PAL



Pal ATHLETIC SUPPORTER

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What folly to rob exercise of its fine health value . . . by exposing delicate cords and membranes to serious strains and wrenches!

In exercise of *any* kind, from tennis to the "daily dozen" . . . *play safe* by wearing an athletic supporter.

• • •

Wear a PAL! It's the preferred athletic supporter of leading colleges, "gyms" and physicians . . . Cool, light, porous, non-chafing. And extremely flexible, affording firm support and *safety* at all times . . . *Physical security* means peace of mind and freedom of action. Wear a PAL and improve your game . . . At all drug stores . . . one dollar. *{Price slightly higher in Canada.}*

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GREATEST OFFER EVER MADE
PUTS THIS OTTAWA TO WORK FOR YOU
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Make Money! Wood is valuable. Saw 15 to 20 cords a day. Does more than 10 men. Ottawa easily operated by man or boy. Falls trees—saws limbs. Use 4-hp. engine for other work. 30 DAYS TRIAL. Write today for FREE book. Shipped from factory or nearest of 10 branch houses.
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Licensed by Rider Radio Corporation. Patented 5-2-'16, 7-27-'26; Pats. Pending

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A True Balancing Device for Radio Frequency Amplifiers

When building a receiver, guard against the squeals and howls of R.F. Oscillations by incorporating Phasatrols in the circuit. If you have a set now, suppress these infernal noises with Phasatrol. It is extremely easy to install without dissembling the receiver.

Phasatrol dampens the circuit and absorbs surplus energy, thus neutralizing oscillations. By adjusting it to the desired value, it is possible to cure even the most obstinate R.F. amplifier tube from the oscillation habit.

Price $2.75 each.

Electrad specializes in a full line of resistance controls for all radio purposes. Write for free installation circulars and full information.

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FOR AERIAL-GROUND AND POWER RECEPTACLE FOR A. C. SETS

Finished in
Satin Brass.. $1.00
Brown Bakelite 1.25
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THIS 148 PAGE RADIO CATALOG AND ENCYCLOPEDIA FREE

Containing 75 radio hook-ups, 500 illustrations, 1000 articles.

Wholesale Prices

Build your own with Rasco parts. The lowest prices in the country.

Radio Specialty Co., 96-P Park Place, New York, N.Y.

Whittled Ship Model

(*Continued from page 115*)

on the other side and fasten them with pegs.

The topmast backstays are hitched to the masthead and fastened similarly. The two stays come to the same place through the holes in the bowsprit and are tied to a hole in the stem, just above the water line.

Fasten the foresail to the mast with a piece of wire through a hole in the inner end of the gaff and a touch of glue down the fore edge. Similarly, fasten the boom to the mast touching the sail, and tie the outer corner of the sail to it.

Step the mainmast and rig it in the same manner; affix the mainsail as the foresail. The gaff topsail should be wired to the masthead so that its after corner touches the gaff and the sheet of the clew comes over the gaff and projects down to windward; from there, a rope should run to the deck.

FROM the mainmast head a stay comes to a hole at the fore lowermast head, with another from there to the main lowermast head. Single lines may be fastened from the lowermast heads to the ends of the gaffs, for peak halyards.

Fore and mainsails should have sheets from the boom to the center of the deck; they are apparently to hold them in at an angle shown in Fig. 1, but serve equally to keep them out if the threads are stretched and varnished.

The jibs are tied to their stays with thin cotton through small holes in the edge of the sails. They have sheets made of twisted cotton with blocks in the end, from which two threads lead to the deck. The outer jib has a double sheet, one straight to the deck to hold it down, the other leading over the stay and to the deck on the other side; if varnished, this sheet also helps to keep the sail in position.

The yards should have braces as shown; single ones from the upper yardarms to the masthead, double ones from the next yard to the same place, and double ones from the lower yard to the topmast heel. Thin cotton will answer the purpose. Each pair of braces may be of one piece to save knots.

The blocks should not be larger than about 1/16 inch; they may be wood, beads, or merely knots in the thread.

The deck fittings are not much trouble to make and add to the finish. Suitable ones are two little posts right forward, with a round piece between to represent the windlass; a fore hatch, between the masts; and a larger one filling most of the space between the mainmast and the stern, with a raised portion on it to represent the scuttle. Abaft this there is a box containing the steering gear. The little wheel attached to the box may be a small watch sprocket or may be cut from celluloid or lead; it should not be larger than ¼ inch. Four or more guns and carriages may be fixed on deck to point over the rail.

IF YOUR ship is to be a merchantman, privateer, or slaver, it will fly the American flag; but if a pirate, then the skull and crossbones on a black ground or the "Jolly Roger." Mine is a privateer, so I gave it also a long pennant, as with a Navy ship.

If you want to paint her, the coloring is simple—black hull and guns; brown masts and gun carriages; white sails and deck fittings (although the latter may be mahogany color); blue or sea green water with whitecaps. I suggest, however, that you first try her with a thin coat of varnish only, or stained and then varnished. If you do not like this effect, you may still paint her.

When finished you will find that you have a dainty little model. It might be used as a paper weight, or have its base extended to form an inkstand, or be adapted for many other decorative purposes.

on *half* of the Keyboard

AND that is what the majority of people who own Radio sets are trying to do . . . And the worst of it is that they do not know any better. They have been listening to "Radioed Music" so long that their ears have become accustomed to only about half of the program being broadcast.

Now it is possible to transform those sets so that all of the program is heard.

The AmerTran Power Amplifier, a complete 2 stage Push-Pull Amplifier and its companion Unit, the AmerTran Hi-Power Box supplying 500 volts to the plates of the Power Tubes will make your set superior to the finest manufactured sets.

Learn what radio can be—listen to the whole keyboard as it is played in the studio. Write to us now and let us arrange a demonstration for you. No obligation, of course, but prepare yourself for a musical treat.

Before you buy a new set—let us show you what your old set, AC or DC, will do when it is brought up to date with AmerTran Products.

AmerTran Push-Pull Amplifier—complete 2 stage audio amplifier. First stage AmerTran Push-Pull for two power Tubes. Choice of standard amplifier or UX 227 AC for 1st stage and two 171 or two 210 power tubes for second stage. Price, east of Rockies—less tubes —$60.00

AmerTran ABCHi-Power Box—500 volts DC plate voltage, current up to 110 ma; AC filament current for rectifier, power tubes and sufficient 226 and 227 AC Tubes for any set. Adjustable bias voltages for all tubes. Price, east of Rockies—less tubes—$95.00

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Kindly arrange for a demonstration for me.

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He's making $6500 *a year now*

"I USED to know him when I was a kid—we went to grammar school together.

"Then his father died and he had to go to work. Got a job with Brooks & Watson as a clerk, but couldn't seem to get ahead.

"Then overnight something seemed to wake him up. He began making suggestions to the firm—helped them to save a great deal of money.

"Then Old Man Brooks became interested—wanted to know how Ned happened to know so much about the business. Ned told him he'd been studying at home at nights through the International Correspondence Schools. 'H'm,' said Mr. Brooks, 'I'll remember that.'

"He did too. Put Ned out on the road as a salesman for a year or so and then brought him into the main office as sales manager.

"He's getting $6500 a year now and everybody calls him 'the new Ned Tyson.' I've never seen such a change in a man in my life. The I. C. S. deserves a lot of credit."

An International Correspondence Schools course will help *you* just as it helped Ned Tyson. It will help you to have the happy home—the bigger salary—the comforts you'd like to have. Start today to make good. At least find out what this great school can do for you.

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Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the subject *before* which I have marked X:

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Ⓢ AMPERITE automatic filament control is officially specified for all of the popular new circuits. Engineers have used and praised it for seven years. Put AMPERITE on *your* parts list. Entirely unlike fixed resistors. A type for every tube—battery or A. C. At all dealers.
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RADIALL CO.
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New York

AMPERITE
REG. U.S. PAT. OFF.
The "SELF-ADJUSTING" Rheostat

Lost in the Arctic

(*Continued from page 17*)

hangar. In sixty-eight hours Nobile had explored 16,000 square miles. Between Spitzbergen and Franz Josef Land they had disproved the existence of a legendary Gillis Land, reported seen two centuries ago. They had made more than 200 photographs, 100 topographical observations, many motion pictures, and had traveled 2,500 miles.

Spurred by this success, Nobile was eager for the crowning triumph—and five days later the *Italia* was heading for the top of the world, 750 miles away.

THAT journey was another triumph for modern communication. Where once it took months for news to reach the public of Peary's historic dash over the ice, millions now listened to history in the making as the *Italia* flashed news of her progress. Twenty minutes after midnight on May 24, after twenty hours of flight, the airship floated over the Pole and dropped her flag and cross. Jubilant messages sped to Italy. For two hours the ship circled about, then began the return journey. Through the night Nobile reported constantly all was well; but in the morning came word that the ship, coated with ice, was battling strong head winds. Then a day of silence and on May 25, a brief message that with all three motors at top speed the *Italia* barely could move ahead.

That was the last. Hours lengthened into days. The gale thundered with increasing wrath. Had the *Italia* been forced down on the ice, dooming her crew to untold suffering and death? No one knew.

With no word nor sign to indicate the *Italia's* position, rescue seemed all but hopeless—in Amundsen's words, "a game of blind man's buff."

But there were men eager to try. First was the Norwegian flyer, Lieut. Luetzow Holm, who embarked for Spitzbergen on the sealing ship *Hobby* with a seaplane and dog sleds. Capt. Riiser-Larsen, Amundsen's right-hand man on the *Norge*, followed with another plane. They were to search the northern coasts of Spitzbergen. Sweden sent a group of army pilots, led by Captain Thorsborg, and including Captain Einar-Paul Lundborg (then a lieutenant), soldier of fortune and dauntless airman. From the *Citta di Milano* went two parties of Alpine climbers with Norwegian guides for an overland search.

NORWAY rushed the ice breaker *Braganza* and two powerful breakers went from Russia. Italy hurried two giant seaplanes, piloted by Majors Maddalena and Penzo. And France offered the speedy new seaplane, *Savoia 55*, built for trans-Atlantic flight, with Captain Guilbaud, to pilot Amundsen on the quest.

A blind search it was, but resolute.

Meanwhile, radio operators in Russia, Holland, and America picked up messages supposedly from the *Italia;* but not until June 8, two weeks after the last previous word, did the *Citta di Milano* get definite signals from Biagi, the *Italia's* operator, that the ship had crashed. Nobile and part of his crew were stranded on the ice off the easternmost tip of Northeast Land, a desolate island to the northwest of Spitzbergen proper, a region of ragged ice more than 200 miles from Kings Bay and on the opposite side of the Spitzbergen archipelago.

Soon messages from Nobile told of the *Italia's* fate. At 10:30 on the morning of May 25, he related, the ship was bucking the wind at a height of 1,500 feet, when suddenly, overwhelmed by the weight of ice, she began to drop and in less than two minutes hit the ice. The cabin, containing Nobile and eight others, was torn away from the envelope, while the bag itself, with seven men in its keel, was blown away across the pack like a toy balloon until it vanished. A moment later the stranded men saw in the distance (*Continued on page 123*)

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Of tempered crucible Spring steel, it has 7 powerful driving edges for large and small screws and 101 other uses—works under obstructions where others won't. Carries like pocket knife—often more valuable.

Also FREE—the "$5,000" Circular giving amazing 125-Picture story of

with its 1-TON POWER-GEAR it Outgrips a 40-LB. Vise!
The "hand-grip" of a tiny Rubber band holds a Bearing Ball—the Hardest-to-hold thing known—against a 300-lb. Pull!

IT IS an Automatic LOCK-GRIP RATCHET WRENCH

No. 3—for all Wire, chain, spring-making, fence work, etc.
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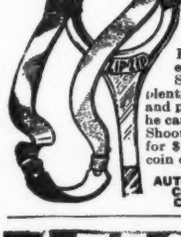
EIFEL-FLASH PLIERENCH KIT
(Say "Eye-fel—Flash") "The T.N.T. of Tools"

You get the amazingly Quicker, Better, Easier, Universal Tool Service of Nos. 1, 2 & 3—Convertible in 1/5 second—in this new 24-Ounce Master Tool Kit—for the Price of One Good Tool; yet it Does the Work of the best other tools Weighing 60 pounds and Costing $50.00!

Hundreds of Thousands of Men and Women are using these wonder Kits to make their Homes and Estates more comfortable—Farms, Shops, etc., more profitable; to get more and better service from Automobiles and all mechanical devices; with an enormous saving in money, time and energy! Used by the U. S. Army and Navy. Just Try a PlieRench Kit Once, and you would no more go back to other tools than to the ancient Ox-cart!

With each Kit is a 64-page Manual of Mechanics
A GUARANTEED SUPER-QUALITY PRODUCT (©'28-J.E.)

If interested in Permanent income of $75 to $200 Weekly—as Factory Representative (full or part time) mark coupon!
MAIL the Valuable COUPON above—NOW!



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AIRPLANE
12-inch scale model of Lindbergh's Spirit of St. Louis. Scientifically designed and very realistic. Only scale model priced under five dollars that will rise from ground by own power. Flies 30 ft. or more and stays in air 8 to 10 seconds. Easily built in three hours. No tools needed. Constructive set, with all parts and full directions, postpaid in U. S., only 50c. (No stamps.) Satisfaction or money back. Send today.
MANN & BENTON Box E Chillicothe, Ohio

A definite program for getting ahead financially will be found on page four of this issue.

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Every "Up-to-Date" Boy Plays the Harmonica

VACATION days aren't half so much fun unless you can pull out a harmonica and show the crowd how you can play—or join with the other fellows in harmonizing the latest popular songs as well as the old-time melodies.

Everybody plays the harmonica *now*—that is, everybody who is up-to-date. Don't be the exception.

Send today for the free instruction book which will show you in pictures how you can learn to play the harmonica in an amazingly short time. A penny postcard will bring it free by return mail. Do it NOW before you forget!

M. HOHNER, Inc.
114 East 16th St.
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FREE INSTRUCTION book, fully illustrated.

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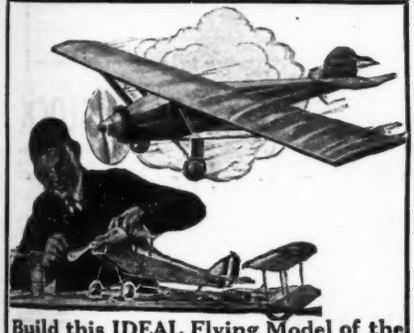

Build this IDEAL Flying Model of the "*Spirit of St. Louis*"

A perfect 3-ft. miniature of the most famous Airplane in the world! Anybody can build and fly it. The IDEAL Complete Construction Outfit contains everything needed; all parts, fittings and materials, full plans, diagrams and instructions. The Model is guaranteed to fly when correctly built.

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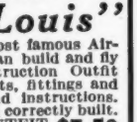
Complete, accurate ¼-size Plans, with Building-Flying Instructions, for any one of the following: New York-Paris; FOKKER; Curtiss; DeHAVILLAND; NC-4 Seaplane; Bleriot; Taube or Nieuport; Cecil Peoli..... *EACH* 25c



Model Book Free with each plan.

64-Page Book for Model Builders

Contains plans for building Gliders and Racers; full information about Scale Models; and most complete catalog of Parts, Supplies, Materials and Fittings for all kinds of Models. Postpaid for..... 5c

Ideal Aeroplane & Supply Co., Inc.
25 West 19th Street, New York City

Lost in the Arctic

(*Continued from page 122*)

a column of smoke—fearful evidence of fire.

Miraculously all but one in the cabin escaped with their lives. Vincenzo Pomella, motor attendant in the stern of the gondola, was crushed to death. His comrades buried him in a frozen grave.

Miraculously, too, most of the food and supplies in the cabin had been saved—enough for more than a month. At first the men found shelter in an ice cavern, then erected a silken tent.

Five days after the crash, Dr. Finn Malmgren, Swedish meteorologist, and Captains Alberto Mariano and Filippo Zappi had set out on foot over the treacherous floes for land. Whether they had survived, no one knew.

The position of the others, on their little frozen island, was critical. The ice was breaking up and moving. They faced imminent peril of drifting to the open sea. Nobile and Ceccioni, motor chief, each had a broken leg. All were weak from exposure. Nobile appealed for medicine, footwear, stoves, and radio batteries.

AMUNDSEN and Guilbaud hop northward from Norway and vanish. And the Riiser-Larsen and Holm planes soar out over the ice pack.

Nobile has painted his tent red to make it visible, but the flyers see no trace of it. The castaways signaling in vain, watch the planes sail by.

Biagi arranges a series of radio signals to guide the flyers. One letter will mean to steer to the right; another, to the left; another, to turn about. And Maddalena, Italian airman, led by the signals, finds the party and drops 650 pounds of provisions by parachute while the exhausted men below him weep for joy.

Three days pass and then comes the most daring and masterly feat in the annals of aviation. The seaplane of Lundborg, with landing skis replacing its pontoons, circles overhead and swoops down like a gull to settle safe on the jagged, drifting ice cake. The castaways can hardly believe their eyes. The thing is impossible. But here he is, under orders to carry Nobile off first. The men lift their wounded commander into the plane, which flies westward to the relief ship *Quest*, whence Nobile is transferred to his own ship at Kings Bay.

LUNDBORG returns to the rescue, but the skis strike a sharp ridge of ice, and the plane upsets and is damaged beyond repair. Lundborg joins the exiles. More than a week later another Swedish flyer, Lieutenant Schyberg, rescues him in turn.

Meanwhile the Russian icebreaker *Krassin* finds and rescues Mariano and Zappi, lost from the Nobile camp for six weeks. Their companion, Dr. Malmgren, has succumbed in the struggle toward land.

Then the powerful *Krassin*, its siren splitting the Arctic wastes, reaches and saves the handful of men dying on an ice cake—Viglieri, in command; Biagi, radio hero; Ceccioni, injured motor chief; Troiani, engineer; and Behounek, intrepid Czech meteorologist who had continued taking scientific observations while awaiting almost certain death.

Now one by one ill-fated rescue parties are themselves saved. With the taking aboard the *Krassin* of the Russian ace Chukhnovsky, who crashed attempting to drop a note from the air telling Mariano and Zappi of their impending rescue, all survivors are snatched from the Arctic save Amundsen's missing party—and, somewhere to the west, seven men of Nobile's crew last seen clinging to the drifting bag, rolling crazily before the wind, that was once the majestic Italia.

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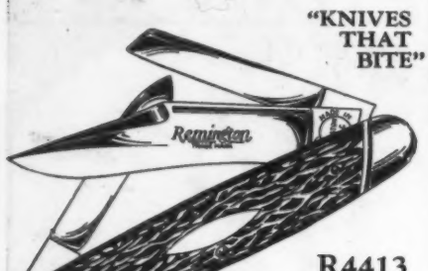

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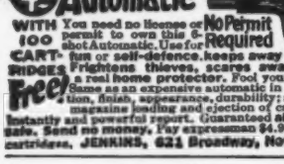

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SPORT FACTORIES, Aurora, Illinois

Air Time-Tables

(*Continued from page 29*)

airport supplement the regularly scheduled airlines; you can rent from the companies operating them a plane and pilot for any local or cross-country trip where the regular air service is inadequate. Thus, Dr. John MacLachlan, of Cleveland, Ohio, used a taxi plane the other day to make a fast trip, without need of connections, between Cleveland and Hartford, Conn. Called to attend a seven-months-old baby stricken with influenza in Hartford, the family physician arrived by air in time to save her life by warding off toxic complications.

Not only independent companies, but many regular air lines operate these taxi services. Their rates vary from fifteen cents to a dollar a mile for each passenger; for long trips the rate is generally higher.

THERE is no mystery about taking a trip by air. In every city along a regular air passenger route is a local office of the airline serving it that will gladly furnish information, rates, and directions to reach the field. If the name of the airline is unfamiliar, it can usually be obtained from telephone information, the local Chamber of Commerce, a leading hotel, or any newspaper. In the same way you can learn the name of an air taxi service. It is prudent to make sure your pilot is a licensed operator flying a licensed plane.

A ride over the transcontinental airway, backbone of the nation's whole system of air lines, is one of the best illustrations of the advantages—and disadvantages—of air travel today. Suppose, for instance, that John Jones wants to cross the continent by air from New York to San Francisco, passing through Chicago en route. He learns that the National Air Transport, carrying mail and express and accommodating one passenger a day when load and weather permit, runs the only scheduled line from New York to Chicago; there it connects with the Boeing Transport's line, longest passenger line in the country, for the remaining 1,949 miles. Of course, Jones could hire at Curtiss Field, N. Y., or Hadley Field, N. J., a "taxi" plane that would take him to any part of the country at a fixed rate of, say, fifty cents a mile; but that is considerably more than the mail line's rate of $200 to Chicago.

At nine in the morning, Jones telephones the National Air Transport and learns weather conditions will permit the Chicago flight. However, the manager must wire Cleveland to make sure that no one else has booked passage from there to Chicago. Otherwise, with the line's one-passenger capacity, Jones could not travel straight through.

THE answer from Cleveland is satisfactory and at 10:15, Eastern Standard Time, Jones boards a Pennsylvania R. R. train for Newark, N. J. There he changes to the local that will carry him to Stelton, a little flag station near New Brunswick, N. J., where Hadley Field, the airline's eastern terminus, is located. He is carrying a small suitcase; only twenty-five pounds of baggage is allowed him without extra charge, and that is the rule with most air passenger lines.

A FIELD manager motors Jones to the field. Soon a new airport at Newark, only half an hour from New York, is to be ready; and it seems likely that air lines serving New York will move to the new terminal at once.

At Hadley Field Jones pays his passage and receives his air ticket, a little larger than a postcard. Now he dons flying togs that the manager provides for him—suit, helmet, goggles, and boots if the weather is cold. He straps on a parachute; in an emergency, he is instructed, he will jump first, count ten, and pull the cord that

(*Continued on page 125*)

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Air Time-Tables

(Continued from page 124)

opens it. That is an almost unnecessary precaution that has an interesting origin; mail pilots, although they are required to wear parachutes, must still, according to the best traditions of the National Air Pilots' Association, stick by a disabled ship unless the passenger's safety is also provided for.

Jones is escorted to the plane he will ride in, a Douglas single-seater mail plane. A folding rumble seat, with a windshield that also folds, has been improvised in the space just ahead of the pilot and behind the motor; into this seat Jones climbs, nodding to the pilot, and mail and express is piled in. With a roar of the motor the plane is off.

At his side Jones notices a little telephone. He holds it to his ear and over it comes the pilot's voice, clear above the racket the motor is making. Jones can converse with him without raising his voice. "Now we're passing the Kittatinny Mountains," says the pilot. A little later, "Here we are, over the city of Reading."

FROM an altitude of about a thousand feet, Jones has a magnificent view of the country. Passing over western Pennsylvania, his pilot-guide points out a caved-in mine. No pilot ever fails to point out that mine, it seems; it is a perennial attraction.

The pilot vouchsafes that he has flown the mail route for thirteen months and he knows every farm. Jones' talk with him is interrupted; he dips his plane, lands at Cleveland, and points out the machine to which Jones must change for his trip onward to Chicago.

Three thirty-five, Central Time—on time to the minute. "Have I time for a bite to eat?" Jones asks. "That's easy," says his pilot, pulling mail bags from the plane. "You can get a box lunch over there at the field office."

Munching a sandwich, Jones climbs aboard the second plane, with a new pilot. A brief stop at Toledo to drop a mail sack, and then promptly at seven o'clock, Chicago's municipal airport at Cicero, Ill., comes into view.

Fifty minutes' rest, before the Boeing plane's scheduled departure westward, gives Jones a chance to stretch his legs, pay $200 for a ticket to San Francisco, and inspect the field with its ten hangars, one brick office building, and a manager's small office. A roar overhead attracts his attention, and a Travel Air cabin monoplane swoops down from the sky. It is the National Air Transport passenger and mail plane from Kansas City, on time at 7:20; five hours sufficed for that trip, though it takes twelve by train. Three passengers step out, carrying suit cases, as it glides to a stop, and are whisked away in a taxicab.

AT SEVEN-FIFTY, the Boeing plane, a two-passenger cabin machine—forerunner of twelve-passenger Fokkers soon to ply the route—soars into the darkening air. Jones settles back on the leather-covered seat for two, at the front of the mail compartment; soon he is sound asleep. A bump and he opens his eyes, startled. The plane has landed at Iowa City for gas.

Omaha next, with a change of planes and a midnight snack of coffee and cookies at the airport. Now Jones can keep his eyes open no longer. Unseen by him, through the night, his pilot flies on to stop at North Platte . . . Cheyenne. Another change of planes; few fly more than 400 miles at a stretch. Hitting the Rockies now, in the gray light of dawn.

Seven in the morning, and he circles to a landing at Rock Springs, Wyoming, to take off again immediately. Morning sunlight bathes the scenery more than a mile beneath in a brilliant glow. For a while Jones watches it scud past, then (Continued on page 130)

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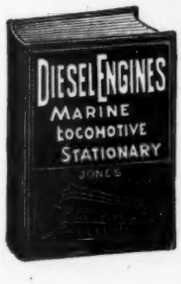

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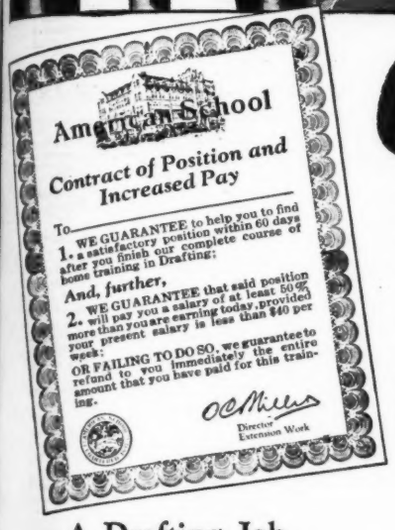
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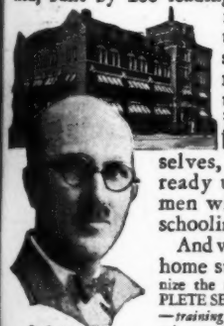

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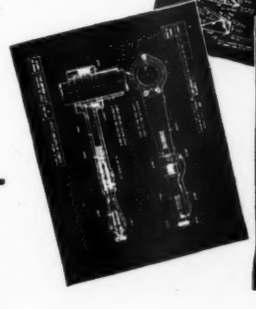

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MAKE money in Photography. Learn quickly at home. Spare or full time. New Plan. Nothing like it. Experience unnecessary. American School of Photography, Dept. 1744, 3601 Michigan Avenue, Chicago.

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SONG Poem Writers. Address, Monarch, 236 W. 55th Dept. 226, New York.

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WANTED—Live foreman or mechanic or clerk in every factory in the United States to act as subscription representative for the most popular magazine in the world. Address Manager of Representatives, Popular Science Monthly, 250 Fourth Ave., New York.

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No matter what make of car you drive, the Stransky Vaporizer is unconditionally guaranteed to give you 50% to 100% more miles per gallon or it costs you nothing. As a matter of fact, it is not uncommon for the Stransky Vaporizer to more than double tire mileage.

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Air Time-Tables

(*Continued from page 125*)

looks at his watch. Breakfast awaits him at Salt Lake City.

A split appears in a range of peaks, the Wasatch Mountains, that cross the magnificent panorama. Through the gap the plane sails, and Salt Lake City flashes into view far beneath.

At ten o'clock Jones' craft lands beside a pair of planes on the Salt Lake field. They are warming up already, awaiting transcontinental mail and express. One, a Western Air Express open mail plane, will forward mail to Los Angeles and take along a passenger or two if any desire. The other, a northbound plane for mail only, is due in Pasco, Washington, seven hours later. It is one of the only four airlines in the country, of the thirty-six in operation at this writing, that do not carry passengers.

THE mail transfer made, Jones' plane crosses the desert, stopping at Elko, Nevada, Reno, and, after passing the Sierra Nevada peaks, at Sacramento, Calif., only two hours from its destination. And at four-thirty in the afternoon, Pacific Time, Jones steps from the plane at Oakland, Calif., the line's western terminus, to motor to Alameda and cross by Southern Pacific ferryboat to San Francisco. His transcontinental trip, costing $400—a figure that may be reduced to $300 before long—was made in a little more than thirty hours' elapsed time, including stops. In other words, he has arrived in San Francisco at the same time that a rail passenger who left at the same time he did, from New York, would still be in Chicago waiting for a fast overland night train.

That is speed. True, it may be disconcerting to learn that you must travel in an open cockpit from New York to Chicago, subject to removal by the pilot at any time if weather threatens; though the trip has not daunted a number of women, one of whom embarked by air from New York to Santa Barbara, Calif., for a golfing vacation.

AND now the last objections are to be removed. Within six months, the National Air Transport announces, it plans to have in operation a luxurious passenger service between Chicago and New York. It has just set aside half a million dollars to buy planes that will carry from fourteen to twenty passengers each. Buffet luncheon will be served on board and two pilots will relieve one another at the controls. Cabins will be roomy, and passengers can recline and even sleep in Pullman type chairs. Soundproof walls will deaden the roar of motors outside. Like the present line, the new one's route will be via Cleveland, with a connecting line to Detroit. At present, day service is planned, with future addition of night passenger planes.

Two other important improvements are in sight for the transcontinental route. Completion of the Department of Commerce's lighting program will now permit night flying across the whole distance, with added planes. And before many months, a projected air-rail line across the continent will be a reality, and a two-day trip by day-flying airplanes and night trains equipped for sleeping comfort will be an important adjunct to the all-air route.

In short, we are just entering an era of air travel. Is it safe? Not an accident in 1,000,000 miles of flying, one airline reports. Convenient? Airports, today, are none too easy to get to; but it's worth the trouble in time saved and the pleasure of a speedy trip. Fast? A hundred miles an hour. How do you start? Just pick up a phone and call the airline's nearest office for time-tables, rates, and directions.

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The Month's March in Science

(*Continued from page 56*)

safely expose your legs and arms out of doors.

Another instrument perfected by Doctor Burt employs a photo-electric cell to measure the intensity of ultra-violet light from the sun at any moment. This intensity varies from day to day. Dr. Edison Pettit of the Carnegie Institution, Washington, says that it has varied more than fifty percent in the last four years, due to changes in the sun itself, and to variations in the earth's atmosphere.

Of this new measuring instrument, Doctor Burt says: "It is so portable and easy to use that the day may come when up-to-date bathing beaches will have observatories to give out the intensity of sunburn light in the sun."

Fossils 600,000,000 Years Old

IN AUSTRALIA, a few weeks ago, was written an epic of the progress of life on earth, from crawling worms to flying men.

At about the time Captain Kingsford-Smith and his comrades were alighting at Brisbane after a record ocean flight across the Pacific, there was announced the discovery, in Australian mountains, of the fossilized remains of the oldest known inhabitants of the earth, who lived some 600,000,000 years ago. Lowly creatures, never before seen, they resembled the sand worms found on modern beaches, and crayfish.

The oldest fossils previously found lived in the Cambrian Age, the earliest period of the age of fishes and invertebrates, probably somewhat less than half a billion years ago.

The new discovery was made with a high-powered microscope by Lieut. Col. Sir Edgeworth David, a former professor of geology at Sydney University, after a search of more than twenty-five years.

It has been hailed by one authority as "opening a new epoch in geology, antedating the birth of life beyond the wildest conjectures of the geologists."

Telescope May See Martians

PROF. G. W. RITCHEY, noted American astronomer, predicts that within the next eight years the world will know whether there are cities and men in the planet Mars.

Professor Ritchey supervised the design and construction of the 100-inch reflector for Mount Wilson observatory, largest in the world. Now, in Paris, he is planning a giant telescope of entirely new design and ten times more powerful.

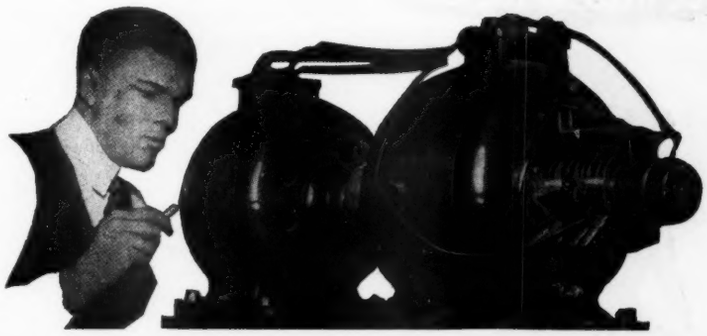
"The largest number of stars which present telescopes have been able to photograph in one cluster," he explains, "has been about 40,000. The new telescope will photograph millions. It will be able to show clearly any densely populated sections of Mars, if they exist."

The telescope will have a mirror nearly twenty feet in diameter, and its construction will be based on Ritchey's discovery of a method of building mirrors of several separate pieces of glass, instead of one huge piece, as told in a previous issue of POPULAR SCIENCE MONTHLY.

Present plans call for a huge observatory beside the Grand Canyon in Arizona.

Events move swiftly in exploration of the sky. And public interest in astronomy grows apace. Reports from Germany say that crowds of American tourists have been flocking to the planetariums established in Berlin and thirteen other cities.

On the white domes of these remarkable man-made heavens, they have seen displayed the fascinating pageant of the stars. Within a year a similar planetarium will be erected in Chicago. Other cities, too, plan to follow the story of the stars.



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Answers to Aviation Questions on Page 36

1. Wilbur and Orville Wright, Kitty Hawk, N. C., Dec. 17, 1903.
2. A catapult launching gear was used.
3. Department of Commerce.
4. Germany.
5. Both have cylinders arranged radially about the crank case. In the rotary engine the cylinders revolve, while in the radial they remain stationary in respect to the airplane.
6. An instrument for indicating the revolutions per minute of the engine.
7. A route for airplanes to follow marked by suitable beacons and provided with emergency landing fields.
8. An air compressor for supplying air to the carburetor, used chiefly at high altitudes.
9. High grade materials and workmanship and small production.
10. Up or down currents of air.
11. 28.5 hours.
12. High and fast.
13. By flying in a U. S. licensed airplane, with a licensed pilot in good weather.
14. 3,610 miles.
15. A cone, mounted to show the direction of the wind.
16. Floyd Bennett.
17. Monoplanes and biplanes.
18. An aircraft, heavier than air, deriving its chief support and propelling force from flapping wings.
19. A high aerodynamic efficiency.
20. No.
21. A fixed or adjustable vertical tail surface to give directional stability.
22. A fixed or adjustable horizontal tail surface to give pitching or longitudinal stability.
23. A hinged or movable auxiliary surface, usually part of the rear edge of the wing, to give lateral control. (Control in rolling.)
24. Cowling is structurally unnecessary covering put on for streamlining the engine.
25. A monoplane with the wing above the fuselage.
26. The principal longitudinal fuselage members.
27. Wood, duralumin, bakelite, and steel.
28. Any part of the structure, long as compared to its width and depth, which is designed primarily to carry a compressive load.
29. Cotton cloth and dope.
30. The Pacific Northwest.
31. Because it is easy to weld. Welds in duralumin are not yet commercially practical.
32. The wheels should be placed forward more to prevent nosing over.
33. A wire having a streamlined section instead of a round or square section.
34. Any form of motorless airplane.
35. .0807 pounds per cubic foot.
36. Reduces engine power, changes propeller efficiency, and more speed or wing area is required for sustention.
37. The suction on the upper surface furnishes from two thirds to three fourths of the total lift.
38. Much higher efficiency is thereby attained. Tip losses become a smaller factor.
39. Into the wind to reduce speed relative to the ground.
40. For tests on models of wings, parts of airplanes, and complete airplanes to determine their characteristics of lift, resistance, and balance.

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Tips from a Veteran Carpenter

(*Continued from page 32*)

molding, and even door and window frames. Common yellow pine may be used to case a window on the outside right next to cedar clapboards, which is like a fake diamond set in platinum. Some fellows vamp window, door, or screen frames out of any kind of scrap lumber, from poplar to whitewood. They put the right stuff in the wrong place, like a tailor who sews the lining on the outside of a coat. It looks just as good when painted, but time shows up the make-believe. This is why it pays to deal with reliable lumber dealers and builders."

"Some persons put a lot of faith in paint," I observed.

"Paint never gets to the inside of a frame after it is set in a wall," said Uncle Ed. "One priming coat generally has to last the hidden part for a lifetime, but moisture gets in and if the wood isn't naturally rot-proof, there's trouble.

"SAME thing with all exposed woodwork, including boards behind gutters, porch floors, and steps. Besides that, where paint is a protection it wears off, and the naked wood has to take the punishment of the weather until the owner gets around to covering it again. The other day I saw rain going right through unpainted cedar siding—the best of material but porous and sliced too thin on the upper part. That's another modern improvement to look out for, reducing the old-time thickness of lumber in clapboards, flooring, trim, and I don't know what else. One inch was pared to seven-eighths, then to three-quarters and one-half minus. The latest is closet lining veneer that needs a micrometer to measure it."

"And could be applied with carpet tacks."

"That's another point, the way some houses are tacked together with the smallest and fewest nails. When you don't hear a healthy racket on a new house and the hammers sound like a band at a funeral, you can guess that the nailing is being skimped. I like plenty of spikes in framing, and not less than tenpenny nails in studs and eightpenny finishing nails in trim. The extra long nail is not always to provide strength, but to hold light material tight against warping."

"Flashing over exposed doors and windows is something that many persons never heard of," I suggested.

"IT USED to be done on all good jobs and is yet. Perhaps I oughtn't to complain about lack of flashing, because that gives me a good many days of repair work every year. 'Our windows are leaking badly on the inside top and sides, Mr. Warner,' folks say over the 'phone. 'Please come and fix them right away.' It's raining and they think I can stop the trouble in a jiffy. The plaster is stained inside, the drip cap outside is probably rotted. It's a slow and expensive job that would never happen if a few extra dollars had been spent on the house in the first place. This trouble is more likely to happen with siding than where the wall is shingled. A film of water collects on the drip cap above the window and is blown under—the joint not being tight when new or worked open by shrinkage later. Then the water runs down the inside of the frame and even into the house. Flashing is a metal strip nailed to the sheathing, bent over and under the drip cap and nailed just below it. It can be handily bent to shape on a two-by-four before putting it in place. The old houses used tin, but now we have copper as the first choice. A dollar's worth of copper on a window will save ten dollars in repairs. Zinc is all right, but does not mate well with the acids in cedar siding or shingles."

"I guess you believe in copper for other flashing, too—in roof (*Continued on page 134*)

Herschel Logan with drawings made (1) before and (2) after Federal School training.

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HERSCHEL LOGAN wanted to make money. He liked to draw, but his work (an example of which is shown in No. 1, the small crudely drawn heads above) was not good enough to sell. Seeing an advertisement of the Federal Schools, he filled out a coupon like the one at the bottom of this page. Now compare his recent work, No. 2, with the crude ink scratchings he did before he enrolled in the Federal Course. The drawing of Lincoln shows that Logan understands the proper application of ink. You can see for yourself how the Federal Course has "steadied" his hand. This is the type of drawing that is simple, strong, masterful and pays big money to the man who can do it. Mr. Logan is just one of hundreds of young people making good money because of Federal Training.

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Tips from a Veteran Carpenter

(Continued from page 133)

valleys and around chimneys, for instance."

"Zinc is good stuff and costs less," replied Uncle Ed. "The fire underwriters class it after copper because it would melt sooner in a fire, but if everybody used either metal for flashing instead of tin or nothing, houses would last longer—and I'd be poorer." He chuckled. "Some people look on first-class material as an extravagance anyway. They can't see the value, for instance, of corner bracing of studs, firestopping, diagonal sheathing, and diagonal subfloors. 'Fads of the carpenter,' they say, or 'What does it matter about that hidden work?' They see time wasted on all careful workmanship that doesn't show."

"That reminds me to ask your opinion on the mitering of clapboards on house corners."

"WELL, it looks neater to miter. But I doubt the job is any better, aside from looks, and maybe not as good as leaving the board ends square and filling the groove with a strip of quarter round. This saves work, and the solid corner is less likely to get damaged in time, or open to the weather like a thin-edged miter. I always fancied the old Colonial style where they finished the corners with wide pilasters—set in pillar effects—which were useful and mighty ornamental."

"Does it pay to use second-hand building material?"

"That's a question that Shem, Ham, and Japhet started to argue on and folks are still at it," declared Uncle Ed. "You can't keep human nature away from what looks like a bargain. The wreckers and junkmen always have customers. You can't expect a carpenter to say he likes second-hand lumber any more than a cook likes to make a banquet out of leftovers. It is hard on tools and temper. The old stuff is full of nails that nick planes and ruin saws. It has split ends that call for makeshift tacking together or cutting off with wastage. It has such a mixup of odd sizes that the carpenter wears himself out figuring how to match this and that. He is always ripping, lapping, shimming, and patching. It takes more than twice as much time and a few more kegs of nails compared with straightaway work on new lumber."

"SUPPOSE a man does his own work on second-hand stuff?"

"Then his bargain is a hundred percent, minus wear on tools and temper."

"Here's a final classic question: Which is better for the owner, day's work or contract?"

"It makes no difference, if the builder is honest," replied Uncle Ed. "But if you decide to contract, keep away from the lowest bidder if you want a job of first quality."

Still Newer Uses of X-Rays

THE list of amazing new jobs for X-rays, as given in the July and August issues of POPULAR SCIENCE MONTHLY, continues to grow.

Recently Dr. F. Holweck, noted French X-ray expert, applied the destroying power of the rays to calculate exactly how much it takes to kill a single disease germ. Imagine, if you can, the force of the blow struck by the smallest visible speck of dust after falling a distance about equal to the thickness of this paper. Then divide that force by a million, and you will have the jolt that can kill a germ.

By making X-ray photographs of ancient Egyptian mummies in the Field Museum, Chicago, Dr. Cora A. Matthews, of the staff of the Cook County Hospital, has been able to determine that children who lived in the time of the Pharaohs suffered from many of the diseases that are common among children today.

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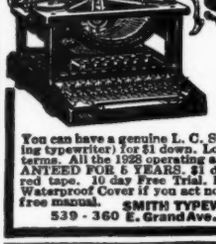

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Is Man Pygmy or Giant?

(*Continued from page 27*)

molecules have to "stand on each other's shoulders" to reach across.

And molecules are the giants of this subvisible world. Each is a universe in itself in which as many as 25,000 suns and satellites whirl at once. Within the molecules are the atoms and within the atoms are the electrons.

Look at this "o". It is so small that it disappears if you move the page a few feet away. Yet, science tells you that corralled within that "o" are a jostling crowd of atoms greater in number than all the stars you can see in the sky!

An article in the July issue of POPULAR SCIENCE MONTHLY told of a discovery announced by Robert A. Millikan, the American physicist who was awarded the Nobel Prize for his work with cosmic rays. He said recent tests led him to suspect that all space is filled with cosmic rays creating fresh atoms. For a long time, we have been told that the earth is wasting away and will eventually disappear. Dr. Millikan's idea that new atoms replace those lost through radioactivity suggests that the earth may last forever.

But even smaller than the atoms are the electrons, little planets that wheel on their orbits at speeds greater than that with which the earth circles the sun.

Imagine that everything around you suddenly begins to swell. The cats and cups and tables and buildings and the earth double, triple, quadruple in size.

THEY keep on until everything is ten billion times as big as it is now. Men would be ten million miles tall. And they would wheel around babies weighing fifty million tons. Mice would have tails so long that they could wrap them about the present equator a dozen times. A bird-shot would have swelled to the size of the earth as we know it.

But, even in such a fantastically magnified world, one of these electrons would have become no larger than the head of a pin.

Looking at such things, how gigantic seems man!

When Charles the First was King of England, one of his bodyguards was a giant who was in the habit of carrying a dwarf around with him in his pocket. If you were asked which of those two, the dwarf or the giant, best symbolizes man, what would you say?

We are undecided, looking at man physically, whether he is a pygmy or a giant. But, viewing him from the angle of the mind, our answer is more definite.

All through his history, he has been fighting forces stronger than he. The lightning, the storm at sea, wild beasts, disease—these have been his hereditary enemies. But by using his mind he has conquered.

In his laboratories he plays with lightning that carries three million volts. On his steamships he plows safely through waves a hundred feet high that drop thousands of tons of water crashing on the deck. His children go to the zoo and are amused by the caged remnants of the fierce beasts that once menaced their ancestors. And disease after disease he has strangled at its source.

MAN, the giant, looks over the rim of the globe and sees a friend half around the earth—by television. He crosses the ocean in a single step—by airplane. He strides across the land faster than the fleetest deer—by automobile.

By using his brain, man has become swifter than the deer, stronger than the elephant, more keen-sighted than the eagle. He has conquered the air, the land, the sea.

Mentally, he has become the giant of the earth.

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CHANCE governs the general trend of too many lives. By chance many people live in a certain place, attend a certain school, take the opportune job; they chance upon certain associates, books, and thoughts.

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Here Are Correct Answers To Questions on Page 73

1. In 1859 there was drilled at Titusville, in northwestern Pennsylvania, the first producing oil well in the United States. From the oil of this well the first kerosene was made. The "rock oil," as it then was called, soon became the general illuminant of the country.

2. In ruins of the famous temple of the sun god, built by the Roman emperor Antonius Pius, at Baalbek, in Syria. The ruins can still be seen a few miles east of the modern city of Beirut. Some of the great stone blocks are more than sixty feet long by nearly twenty feet square.

3. The Great Barrier Reef is a long fringe of coral reefs on the northern coast of Australia. It is the longest in the world.

4. Such socks are worn with the native Japanese footwear which is provided with a string to go between the big toe and the other four.

5. In South Africa there lives a curious kind of fish called the "mudfish." When the rivers dry up in summer, the mudfish make themselves little nests in the mud and simply wait there until the river is full of water again. You can dig up the clods of mud containing the live fish.

6. The only places are the salt desert regions where the dry ground is saturated with salt or soda. In the United States the only such region of any size is the Great Salt Lake Desert, west and southwest of Great Salt Lake in Utah.

7. Most of the first-quality asbestos comes from Canada, near Black Lake, about sixty miles south of the city of Quebec. Small quantities of asbestos have been found in many other places in the world.

8. This name has been applied for generations to the city of Bucharest, capital of Rumania, anciently a province of the Roman Empire, from which its name is derived. The site of Bucharest was originally occupied by the Romans. Its fancied resemblance to Paris is no doubt based upon its showy avenues and boulevards.

9. Nothing at all. This is merely an accidental similarity of the two names. Cocoa is a chocolate product from the seeds of the cacao plant. The main source of the coconut is in the East Indies, whereas the chief supply of cacao comes from the West Indies.

10. Geologists believe that the great Andes Mountain chain on the western coast of South America probably is the youngest mountain range. This is indicated not only by the general geological character of western South America, but also by the great height and steepness of these mountains. Older mountains have had time to be worn down.

11. These famous people belong to the San Blas tribe of Indians, living in Panama on the South American side of the Canal Zone. Some individuals in this tribe are almost white. The "white Indians" are really not a separate race, but are a variety of albino, belonging to the ordinary native race of the region.

12. This distinction is believed to belong to Panama City, at the Pacific end of the Panama Canal. This city was founded by the Spaniards in 1519.

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Gains *in* Conquest *of the* Air

(Continued from page 48)

That is the recent conclusion of the U. S. Department of Commerce, based on Germany's record of 5,713,200 miles flown last year and this country's estimated 5,700,000.

Passenger travel by air in particular, a phase of aviation slower to develop here than abroad, is expected to gain most in 1928, with greater provisions for comfort on air lines. The Department's announcement stresses the fact that in this country aviation, unaided by Government subsidy, is successfully paying its own way. Not one of our 12,000 miles of air line is subsidized, although France, Germany, and England meet the deficits of their own air transport agencies.

Tests Show How Fast We Fall

IF YOU jump from a plane, the greatest speed your body will attain is between 100 and 120 miles an hour no matter how far you fall. That is the surprising discovery of the U. S. Navy's Bureau of Aeronautics, based on night-experiments with flare-lighted dummies at Wright Field, Dayton, O. These dummies were hurled from high-flying airplanes. Cameras recorded each dummy's fall as a streak of light, broken every second on the ground by a momentary, carefully timed wink of the shutter; thus permitting measurement of the speed of fall by the length of the light streak after each second.

After only 1,600 feet of fall, the dummies had reached the maximum speed or "terminal velocity" of 100 to 120 miles an hour—only half the calculated speed of falling bodies after traversing this distance when the air's resistance is not taken into account. In fact, an airplane in a dive might even descend faster than a man could fall, and a pilot leaping clear of a falling plane might well wait awhile, the tests showed, until he slowed down before opening his parachute, so that he would not suffer so abrupt a jerk as the chute opened.

Automobile Men Turning to Air

FORMATION of an aviation equipment department, with branches from coast to coast, is contemplated by the Automotive Equipment Association, according to its president, Arthur C. Storz. Such a step would signalize the entry of automobile makers as a whole into airplane servicing; and, Storz declares, many individual automobile manufacturers and jobbers are already supplying near-by airports with aviation equipment.

Further evidence that the automobile industry as a whole is turning to aviation is seen in the announcement that Inglis M. Uppercu, president of a great American motor car sales concern, is also to head a newly formed company at Keyport, N. J., to commence quantity production of the Klemm "flivver" monoplane. This diminutive two-passenger plane, a recent importation from Germany that is said to cost but a cent a mile to run, is to be turned out in lots of a thousand each.

The airplane industry still has a long way to go before catching up to motor production; only 2,000 planes were built in the United States last year. Many orders, however, went unfilled; and this year's production is expected to exceed 4,000. At least two aircraft concerns propose to establish factories, at St. Louis and Colorado Springs, respectively, that will turn out a plane a day.

Combined Plane and Bus Lines

MOTOR bus and airplane facilities are combined in the latest rapid transit project, similar to the proposed transcontinental air-rail transport. It is planned to operate fast airplane passenger planes in conjunction with existing motor bus routes between Detroit, Kansas City, and Salt Lake City.

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New Magic Worked by Cameras

(Continued from page 26)

Dr. C. E. K. Mees, director of research of the Eastman Kodak Company; and later to project a film that shows the whole structure literally leaping from a bare foundation into its finished state, with delays and progress along the way strikingly revealed.

Another odd form of camera motion study has recently been tried in German factories to find out how many waste motions workmen were making. A "still" camera was trained on a factory room and each man in turn was required to work in a lightweight harness studded with tiny electric lamps. The plates, when developed, showed a maze of streaks from the moving lamps, tracing every movement of the worker and showing many that could be eliminated to advantage.

Not only can the camera photograph things you might see if they happened slowly or fast enough—but it can picture things you could never see because your eyes aren't built for it! Things like X-rays—like ultra-violet rays, or "black light," a component of sunlight—and like infra-red, or invisible heat, radiations simply fail to register on the human optical apparatus. But the camera catches them. We are forever blind to anything "redder" than red, or "more violet" than violet, the two colors that are the extremes of our visual span; but there the camera is just commencing.

THAT is why the camera is so valuable in any kind of chemical or astronomical analysis in which the spectroscope, a device to split light into its whole range of visible and invisible colors, is used—an analysis, for instance, such as that which resulted in the discovery by two University of Illinois chemists of the new chemical element illinium, not long ago, through the photographic evidence of hitherto unseen lines in the X-ray spectrum, or light-band, of a mineral used in the manufacture of gas mantles.

Cameras solve vexing problems of acoustics in an ingenious process devised by R. F. Norris, acoustical engineer of the C. F. Burgess Laboratories, Inc., Madison, Wis. Hitherto it has been extremely difficult to predict in advance whether a lecture hall or auditorium would be filled with annoying echoes of a speaker's voice. In the new process a model of the hall is built from the architect's plan, a strip of polished metal borders it to represent the wall, and a small electric light is placed where the speaker will be. Then the whole model is placed in a dark chamber and photographed.

STREAKS of light reflected from the metal "wall" indicate also the path that sound waves will take, since a sound is reflected in much the same manner as a light beam. By altering the position of walls until the camera reveals that light rays, and therefore sound waves also, are evenly distributed over the entire hall without excessive criss-crossing from wall to wall, echoes are eliminated.

And the value of X-ray photographs needs no comment. They reveal everything from hidden flaws in metal to the innermost constitution of the human organism. In medicine and surgery they are immediate means to diagnosis and cure. They detect forgeries, alterations of checks, and counterfeit money.

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Prof. William D. Harkins, of the University of Chicago, recently exhibited to members of the American *(Continued on page 139)*

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New Magic Worked by Cameras

(*Continued from page 138*)

Chemical Society some of the hundred thousand photographs he has taken, showing the tracks of helium atoms or particles made visible by their microscopic trails of water vapor. Thirty of the photographs, he said, had caught the actual event of an atomic collision—a fascinating event that throws light on the atom's real structure.

Meanwhile Dr. Carl E. Seashore, of the University of Iowa, has discovered that all music and speech, since it can be reduced to a mere mechanical pattern of waves in the air, can be recorded and analyzed by photography; and he has devised a motion picture apparatus to record singing ability in terms of cold, impersonal charts of the singer's voice.

Another contributor to the unusual uses of photography is Dr. Walter S. Adams, of the Mount Wilson Observatory at Pasadena, Calif. By taking pictures of Mars and other planets by red, yellow, green, violet, and ultraviolet light in turn, he has made important new studies of their atmospheres and temperatures.

MOST important of all photography's uses, however, is its ability to see more accurately than the human eye—and to preserve an indelible record of what it sees. That is why every industry and every science, as well as many a law court, calls upon the camera for its unfailing record. Go to any great corporation, any factory or industrial concern, and you will find drawer upon drawer of photographs that have recorded for all time everything from the building of a dam to the forging of a bolt. And science esteems the camera as highly as industry.

Astronomers in this modern age need hardly ever look into the barrel of a telescope. In photographs they have records far more valuable than any observation made by eye. Once-tedious star counts of the sky are now replaced by the "patrol plates" of great observatories, detailed sets of photographs that survey the heavens at regular intervals and are kept on record forever.

NO LESS infallible is a novel type of instrument known as the factograph camera, recently developed for the speedy reading and recording of telephone meter figures! It is an ordinary camera into whose oversize hood has been built a bank of electric lamps run on dry batteries, supplying its own light. When its square nose is pressed against a meter the meter face is flooded with light and the film records a picture of the dials. Of course this camera has a host of other uses, for it can copy any document, signature, or paper against which it is pressed.

TAKING pictures of valuable gems, to identify them in case they are stolen, is a practice recently adopted by Paris jewelers that again makes use of the camera's unforgetting eye for detail. According to the National Jewelers' Association, it is expected that such photographs, revealing the most minute details of cut, size, coloring, and any imperfections, will instantly identify any stolen gem and make things unpleasant for the professional thief or fence.

Meanwhile, in America, a special camera has been designed to photograph on a single strip of motion picture film all the checks passing through a bank. The record thus obtained minimizes risk of fraud.

These are a few of the ways by which the camera, whose highest aim was once to take a picture of somebody's relative, has become a priceless servant of industry and science.

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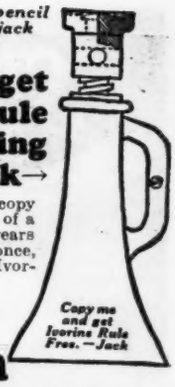

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DICK BYRD—Adventurer

(*Continued from page 39*)

may strike the public as being less colorful.

This new work is the series of side flights Byrd will make east and west of his route to the Pole itself. Already Scott and Amundsen have traversed this route afoot. But the tiny "pie-slice" they cut from the unknown continent leaves vast areas on either side which Byrd will see for the first time by air.

Suppose the entire surface of the United States had never before been seen. What an adventure it would be to traverse it before any other human being! The Antarctic continent presents just this alluring possibility to Byrd, save that it is mostly snow-buried and may contain no form of animal life.

Yet there is always the enticing thought that there may be wide areas that are not under ice and snow. Witness Peary's experience in 1897, when he stepped down off the Greenland ice-cap on almost the very shores of the Polar Sea and found an extensive land totally bare of ice and snow, filled with flowers and inhabited by musk-oxen and Arctic hares. He even found distinct traces of human habitation.

THE scientists with Byrd know that he may find new species of animals, active volcanoes, precious minerals, strange phenomena new to human knowledge, and a score of other fascinating possibilities. Indeed, it stirs the blood of any man to contemplate this last great geographical secret succumbing to the bold enterprise of an American airman.

The cost of the expedition will be in the neighborhood of $750,000. It will be the largest and most splendidly equipped ever sent to polar regions. Every iota of past experience, native ingenuity, and man's inventive genius will go not only into the scientific equipment but into such items as the clothing, food, housing, and medicines of the party.

It is not easy for the average man to picture Byrd's life on the Antarctic plateau. He will live in a temperature averaging a hundred degrees colder than at home. He will eat pemmican and biscuit. He will wear clothing of skins. He will move for nearly four months in darkness and for an equal number of months in perpetual sunlight. The other months will be lit by a curious steely twilight peculiar to the Antarctic regions.

HE WILL keep alive, as though it were a throbbing human heart, one of the finest short-wave radio sets that have ever been put together. His installation is of no standard make. It is being designed and built with the assistance of the best brains in the United States Navy, the United States Department of Commerce, the United States Bureau of Standards, and several large commercial manufacturers of radio equipment.

Its cost will be somewhere near $25,000. It will require antenna height of less than 100 feet, and yet have a radius of operation of over 12,000 miles. Byrd expects to talk daily with New York, sending through a brief word picture of his life that the American people may follow comfortably the exciting sorties he will make into the unknown.

Remember that the seasons south are reversed. Thus on a scorching July day next summer when we wretches are gasping for a breath of air we may expect to read in our daily paper:

"*As sun now gone two months, we are in complete darkness. Temperature at headquarters seventy-one degrees below zero. Wind ninety-four miles per hour. Drifting snow. All well. Byrd.*"

Two groups of his party will not find such conditions very trying. These are his dogs and Eskimos.

"My greatest problem will be to get them south," he laughed the other day. "Guess I'll have to put both (*Continued on page 141*)

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DICK BYRD—Adventurer

(*Continued from page 140*)

on the ice while we are crossing the equator!"

But he was serious enough. Remember that the Eskimo dog as well as the native of the far north is accustomed to a temperature range of thirty-five degrees above zero to eighty degrees below. The dog perspires through his mouth and sleeps out of doors even in the coldest weather. The native wears loose skin clothing and can sleep in the open *sitting* behind a windbreak when the thermometer is in the minus fifties.

Further, both dog and man are used to an exclusively meat diet. They can digest and assimilate masses of oily flesh, mostly raw. To follow such a diet in the tropics would not do well; yet to shift to vegetables or other lighter foods might be fatal.

I traveled for several years with Nucarpingwah, one of the Greenland Eskimos Byrd hopes to take with him. This hunter is about four feet seven inches tall and weighs less than one hundred and thirty pounds. He is stockily built, has never had a bath, and prefers raw meat to cooked. The only food he eats regularly besides meat is raw eider duck eggs.

"You see," Byrd reminded me, "he will not realize that we are going to the southern end of the globe. He'll think he is back home when he sees the ice and snow again. Then where will I be when he asks about the Polar bears and walrus?"

IN THIS connection Byrd has carefully studied all types of sledges. He will need strong ones if only to carry the 100 tons of seal flesh which he must collect in the Bay of Whales for his dogs.

The sledge Byrd has decided on will be nearly the same as Amundsen's. He will not need an Eskimo sledge because he will not travel on sea ice; and he must have wide flat runners to ride over the deep snow of the South Polar glaciers. Hence his favor for the Norwegian type which weighs less than thirty pounds, as compared with Peary's rugged 100-pound framework built to withstand the chaotic pressure floes in the far north.

To supplement the dogs in hauling loads he is taking two 100-ton tractors. These will help hoist his heavy cargo from the ship's boats up on to the ice barrier. They will also haul loads of provisions to depots near the headquarters, from which the dogs will in turn haul smaller loads to other depots farther away. Lines of depots about 100 miles apart will radiate in several directions from the base.

"I wish we'd had a tractor in Spitzbergen!" exclaimed husky Tom Mulroy to me as I was writing this piece. "It took every ounce of strength the crew could muster to get our big plane up the snow slide for its take-off."

This gives another important duty for the tractors. They will no doubt be used to drag the ponderous Ford tri-motored plane up the icy glacier's face behind the base in order that it may find a run long enough to get up and away from the Pole.

There will also be a large Fairchild plane for long side trips in search of new land, and a smaller plane for reconnaissance or rescue work. The Ford, at least, will have a radio able under proper conditions to reach the base.

One unique part of the plane equipment will be automatic cameras pointing downward that will permit Byrd to bring back an accurate photographic record of the new territory over which he will pass. Thus for the first time in history an explorer will bring back a visible record of vast discoveries.

If he can do this, besides planting the Stars and Stripes at the Pole, and making a thorough scientific scrutiny of the land he finds, he believes his expedition will have been worth many times the money, effort, and travail that it costs.

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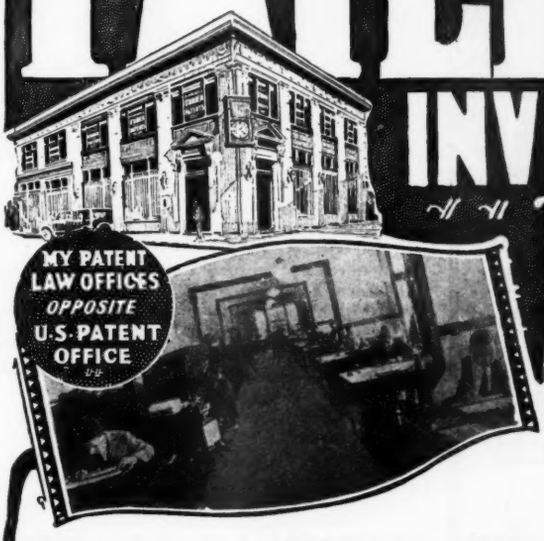

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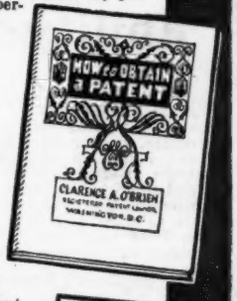

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Do You Know How Your Icebox Is Built?

(Continued from page 33)

box in Photograph 2 is of very poor construction as far as insulation is concerned, although in appearance it ranks with the others. This box, as the illustration shows, was cut in two, revealing that the heat insulation consisted of nothing but a one-inch air space and two skimpy layers of felt. At 80°, this box maintained an average inside temperature of about 64°. Even in the coldest part of the box, directly under the ice chamber, the temperature was 56°.

THESE tests, made with the boxes filled with ice, the doors unopened, and conditions as favorable as possible for the iceboxes, proved improper insulation even before the boxes were ripped open.

It doesn't take much imagination to picture the sort of food preservation you would get with still cheaper boxes, kept only partly filled with ice, especially with the doors opened as frequently as in normal use!

The iceboxes tested are in no sense "horrible examples." They are as good iceboxes as can be obtained at the prices. Investigation of insulation is necessary in selecting a good refrigerator.

If you are considering the purchase of a new refrigerator, write to the Popular Science Institute of Standards for the latest edition of the booklet, "Refrigeration for the Home." It contains information on various types of refrigerators, important points to keep in mind when buying, and directions for proper care. The price of the booklet is twenty-five cents. A list of tested and approved refrigerators will be included. Address your letters: Popular Science Institute of Standards, 250 Fourth Avenue, New York.

Great Oceans Under the Ground

FEW people stop to realize that the ground under their feet is full of flowing streams and rivulets. Yet, according to the latest estimates of Dr. Chester A. Reeds, of the American Museum of Natural History, the water under the ground is equal in volume to one third of all in the oceans!

This water, says Doctor Reeds, has been gathering in the ground for ages. In some places it probably goes down to a depth of six miles. Trickling through the rocks, it forms subterranean waterway systems, such as are found in the Mammoth Cave in Kentucky and the Endless Caverns in Virginia.

Lakes which have their outlets in hidden streams are more or less common. In the Snake River Basin in Idaho, a river flows beneath volcanic rocks. And below Shoshone Falls, in the same region, underground water bubbles forth in beautiful springs at the rate of more than three billion gallons a day.

Meteors Cause Imitation Quakes

SOME weeks ago a giant meteor flashed like a bombshell across the skies above Georgia and South Carolina. Startled inhabitants reported a severe accompanying "earthquake." Houses trembled, window panes crashed.

Can meteors cause earthquakes?

An answer was supplied by Prof. Charles P. Olivier, of the University of Virginia, president of the American Meteor Society. "No," he said. But the air waves stirred up when a meteor plunges through the earth's atmosphere can shake buildings with their force. And the effects are almost exactly like those of an earthquake. A meteor, he said, may travel as fast as twenty-five miles a second—fifty times the speed of a shell from a big gun.

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What Good Is Automobile Insurance?

(*Continued from page 68*)

company is bound to pay the other fellow's damages assessed against you or agreed upon. Your steering knuckle breaks and your machine crashes through a plate glass window, for which the company must pay.

But suppose you smash your new car into your old one inside the garage, no liability. Or suppose you are taking home an expensive radio set which is damaged in a collision.

Here's what the policy says:

"The company assumes legal liability for the injury to or destruction of the property of other persons, but *excluding* the property of the assured, or in charge of the assured, or any of his employes, or carried in or upon the automobile of the insured."

Suppose some friend, thinking to play a joke, appropriates your car for a "joy ride" and has a crash. The company is not liable.

THE coverage holds good while the insured car is being operated by any persons with your permission, or with the permission of any adult member of your household, other than a chauffeur or domestic servant. But:

"The indemnity extended to persons other than the assured *shall not* apply if the automobile is being used as a public automobile, or is owned or *operated* by any automobile manufacturer, dealer, garage, repair shop, or service station, unless the laws of the state in which this policy is issued provide to the contrary."

Keep that in mind the next time you ask the garage man to drive your car home. If he should smash it up, or kill or injure somebody——?

Members of your family may sue you, under your personal liability insurance, and recover in the courts for any injuries received while riding with you in your car. Recently a mother, as "next friend" to their minor child, sued her husband and recovered $1,000 damages, which the insurance company had to pay. The boy had been severely cut when his father drove into a parked machine.

Perhaps it is well enough known (but it should be remembered) that if your car is being driven by anyone under the legal age limit, or in any event under sixteen years of age, the insurance company may disclaim all liability.

Your insurance is automatically canceled when your car is being driven "in any race or speed contest," whether on a race track or speedway or not.

IF YOUR car is being operated "in any illicit or prohibited trade or transportation" and something happens to it, the insurance company can revoke the policy completely.

Be careful and accurate in your statements when you are applying for insurance, for a clause specifies that "misrepresentation of any material fact or circumstance" relieves the insurance company of all liability.

The policy specifically relieves the company from payment of any damages "caused directly or indirectly by invasion, insurrection, riot, civil war, or commotion; military, naval, or usurped power, *or by order of any civil authority.*"

A few weeks ago a policeman commandeered a passing automobile and directed the driver to pursue two fleeing robbers. The machine crashed into another car, wrecking both, and hit a lamp-post. The company refused to pay, holding that the damage was caused "indirectly by order of a civil authority!"

Cleaning Glue Off a Workbench

SPRINKLE wet sawdust on a cabinetmaker's bench encrusted with glue. When the sawdust is removed after twelve hours the glue comes with it.

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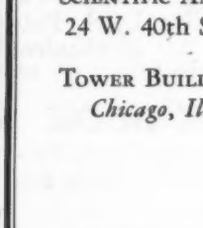

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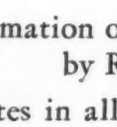

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New Jobs for Old Metals

(*Continued from page 20*)

capable of making alloys almost as light as water and destined, optimistic chemists hope, to be perhaps as important as aluminum. Four other metals still relatively unused are potassium, sodium, rubidium, and caesium, all of which become so angry when anyone gives them a drink of water that they burst into flame. The familiar experiment in which a bit of metallic potassium catches fire when thrown into a dish of water will be remembered by every student of chemistry. This very ability to explode at the touch of water may have utility. For example, it might be possible to obtain power from the metals of this group by allowing water to act on them as acetylene is made by dropping water on calcium carbide.

ONE of the most romantic stories of job hunts by the elements is that of boron, the element of household borax. Borax was the first chemical ever used in industry, for it was at least six thousand years ago that prospectors gathered it in the deserts of Central Asia and brought it on yaks and camels to the civilized towns of Babylonia, one of which was to become twenty centuries later that famous Ur of the Chaldees where Abraham was born. Here the king's goldsmiths used borax to purify and weld the metal of those beautiful crowns and headdresses and necklaces dug up from the ruins of Ur and other cities. Without boron those marvelous examples of the world's first jewelry might never have been made.

For many centuries boron held that job, but in time the goldsmiths found better and cheaper chemical helpers and boron turned to helping other metal workers; to purifying copper, for example, and aiding to weld iron. These jobs, too, proved temporary, and boron's next try was with the canners of food and the preservers of meat, where one of its compounds, boric acid, was much used to prevent decay by microbes. Sanitary officers, led by the famous Dr. Harvey W. Wiley, finally chased boron out of this job and new work was found in making soap and cosmetics such as borated talcum powder. Some of these jobs boron still fills successfully. Within the last few years boron has found two other big jobs—helping to make the smooth white enamel of modern bathtubs and other plumbing fixtures and making glassware which will stand heat well enough to be used as cooking utensils.

THESE new jobs have enormously increased boron's work, but production has increased even faster, so it is hunting more tasks.

Among the elements that are overworked instead of underworked the chemical employment agent gets his loudest howls from tin. Tin cans represent, perhaps, the greatest invention ever made by man, for they and the ways of using them enable us to carry over a food supply from one season to another. The tin on a can is only a paper-thin layer on both sides of a sheet of iron, but so many cans are used that the known deposits of tin ores are almost exhausted. There are very few chemical problems crying so urgently for attention as that of finding a helper for tin.

Lead is another element that begins to see a threat of overwork ahead of it. It is the only known material that can properly protect underground electric cables. More and more cables are laid each year. What element is to protect them when all the lead has been used up?

The only liquid metal, mercury, has a job waiting for it—running boilers in electric power houses; for the mercury boiler perfected by engineers of the General Electric Company is reported as more efficient than the usual boilers using water and steam. Unfortunately, there is not enough

(*Continued on page 145*)

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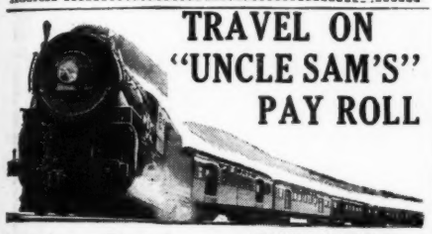

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New Jobs for Old Metals

(*Continued from page 144*)

mercury known to exist in the world to justify wide development of this plan.

The hard, platinumlike metal called iridium is much overworked, making pins for artificial teeth, springs and fastenings for jewelry, and the hard, whitish tips on the undersides of the nibs of fountain pens. Another platinumlike metal called osmium is the heaviest substance known, nearly twice as heavy as lead. It would be useful for weights, but enough of it has never been found.

A few years ago platinum was a standby of the chemical industry because it will stand high heat and resist acids. About the time of the war platinum got a new job in making jewelry. This paid better and platinum walked out on the chemical industry completely, which is why chemists still get mad whenever platinum jewelry is mentioned.

The chemists' employment offices for elements have had their successes, of course, as well as their failures. Only a few years ago aluminum and tungsten were sitting around with nothing to do. Now aluminum is the basis of one of the great industries of the world with a thousand jobs, ranging from construction of great airships like the *Los Angeles* to the making of tubes for tooth paste.

Tungsten, as everybody knows, is responsible for the modern electric lamp.

MORE recently still neon, a gaseous element, unemployed for twenty years, has found employment in making the neon tubes used by experimenters in television and the new lamps which now decorate so many city streets with words written in reddish fire.

Chromium, a century-old metal, has at last found an extremely useful job in plating metal tools and machine parts to make their surfaces almost as hard as diamonds. Perhaps most spectacular of all, chlorine gas, used as a war weapon, is now at work bleaching most of the paper and much of the white cloth that is made in the world.

There are still many jobs waiting to be filled. One thing badly needed is a good insulator of heat; preferably a metal, although many scientific men deem that too much to hope for. Better metals to conduct electricity are needed; better even than copper or aluminum. At temperatures of 460 degrees below zero or thereabouts lead and several other metals become better conductors than copper, aluminum, or silver. What we need is something which will have these desirable properties at ordinary temperatures.

Conversely, something that will resist electricity more perfectly is needed. Glass, rubber, and all the ordinary insulators break down when the voltage is great enough.

Metals to concentrate magnetism are also desirable. Progress has been made in these magnetic matters recently by the new permalloy, an alloy of nickel and iron, and by some cobalt-iron alloys. There is need for a cheap metal that will stand white heat indefinitely without oxidizing. Metals or other substances that will slip past each other without friction would give us machine bearings able to run without oil. Every one of these jobs is believed possible to fill. The only trick is to find just the chemical workmen to suit. Whoever has the skill to do it, will benefit the world and make himself and others rich.

An Easier Way to Fill Sacks

WHEN a number of sacks must be filled, holding them open with one hand becomes exasperatingly clumsy. An easier way is to drive four curved nails around the inner rim of an open barrel, and suspend each sack within the barrel. When filled it is easily removed to make room for another.

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Jerry Smashes Through

(Continued from page 24)

trying to buy his Drumwell-National stock."

The tool dresser grinned.

"Somebody thinks we're going to get there, do they?"

"Well, I don't know." Jerry opened the letter and read: "'I know several others who have also been approached, but nobody was offered more than about fifteen cents on the dollar. This fellow claims that the well cannot be successful, because it is still blocked and it is being drilled crooked. I thought I would write and ask you what you think.'"

"Fifteen cents doesn't seem like much of a price, does it?" Medford mused. "What you telling him?"

"I'm writing him to hold his stock."

"Sounds to me like good advice."

"And I'm suggesting that he tell his friends to hold theirs."

IN DRUMWELL, the vague reports of progress at the well were followed with interest, dampened somewhat by the earlier failures of the six wildcats in the same territory, but nevertheless alert for what might prove the opening of a new pool comparable to the one to the south. The pumping of the walking-beam and the run of the bailer were discussed in post office, bank, cafe, and store.

"They're still drilling up there."

"What they going to do about that crooked hole?"

"Oh, Jerry Crandall knows what he's doing."

Day after day the same topics were reviewed. Then there was a flash of real news for the discussions.

Jerry had come racing down Broadway and skidded to a stop in front of the Gibbsy-Smith supply house. He had picked out two fishing tools, loaded them into his car, and gone speeding back. Now it was reported that an extra cable had been delivered to the well a week before.

Further details became known. The hole had been drilled around the end of the lost tools, virtually undermining them. They had slid downward on top of the working tools and pinned them in. But now they were loose in the hole and could be reached.

Purdy Vincent Bolton was surprised. His soft fingers fluttered among the papers on his polished desk.

"What do you think of that!" he exclaimed.

HE WALKED to the door and back, and the floor creaked under his huge bulk. A couple of young fellows were loafing in the office, talking of the developments. He sent one to call Crandall to him.

Notwithstanding the summons, it was the next morning when Jerry appeared at the office.

"Couldn't leave sooner," he explained.

"A very interesting situation, is it not?" the vice president commented, smiling.

"Very," replied Jerry.

"I congratulate you upon the impending success you seem to be coming to. I confess that you have surprised me. And I want to coöperate in every possible way I can. I am engaging Mr. Norden to help you recover the tools from the well."

"They're already recovered. We got them out at 4 A.M."

The vice president's jaw dropped, and he grinned sheepishly.

"Did you—was—is everything all right?"

Jerry looked at him as if not knowing how to judge him.

"We're going to fill the crooked part with rock now, and drill it straight," he announced.

"Yes—yes, indeed. Of course." Bolton's first apparent confusion was vanishing. He spread his fingers on the desk. "I shall help you speed the progress. We shall start two shifts. Mr. Norden can start *(Continued on page 147)*

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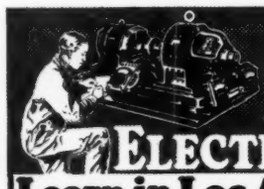

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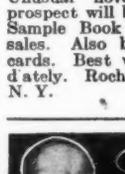

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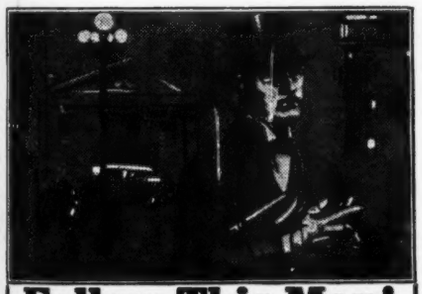

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Jerry Smashes Through

(Continued from page 146)

now." Jerry detected a sly note in his voice.

"No, not Mr. Norden, please."

Jerry's gray eyes were cool, but little ripples were playing under his jaw. Bolton was rubbing his hands perplexedly.

"I hardly understand," he protested. "I don't grasp your meaning, young man."

"Norden was driller when those tools fell into the well, wasn't he?"

"Yes. Yes. But an accident—you know that anyone——"

"I'll tell you, Mr. Bolton. I feel a sort of responsibility in this. I talked the company into letting me go ahead with the well. If Norden comes back on the job, I'll quit."

"Now—why—do you realize——?"

"Yes. I realize. But I'd rather not talk about it, unless I have to quit. Of course if I quit, I'll explain why."

"OH, WE'D hate to lose your services," said Bolton hastily. "There's no need for—now just go ahead, and we'll forget about the Norden matter. You just go ahead and continue to operate as you have been doing."

"All right, Mr. Bolton. I think we're going to get something in that well."

The tools were pounding in the hole again, smashing their way straight ahead now. Jerry marked the progress, feeling the cable and giving another turn to the temper-screw on the walking-beam to let the line lower, so the hungry bit at the end could bite further into the rock.

A fierce sort of joy showed in his eyes as he took turns with the sledge, dressing the extra bit now dulled and battered from its work. His bared arms were flashes of sweating tan in the sun as he rained blows upon the glowing metal. Medford grinned in admiration as the hot steel took form, edged and true. It was a better job of tool dressing than he could do.

"That is a beautiful job."

Both men turned to see Bolton smiling in at them. He stood with one immaculate boot raised to the drilling floor and a large pink hand resting on his knee.

"Yes, sir," he said. "That is the kind of thing I like to see. How are you progressing?"

"Pretty well," Jerry replied. "Of course it's slow. Limestone formation just now."

Bolton nodded understandingly. He stepped in upon the floor.

"A BEAUTIFUL job you're doing, though. It's a pity it isn't thoroughly appreciated." He shook his head, slowly, and crinkled his ruddy forehead. "You know some of the stockholders are getting quite pessimistic about expenses. Now if they could just see you working there, dressing that bit—" He smiled a moment, and then became serious again. "The trouble is, though, there doesn't seem to be much hope of finding oil. That is the way they feel, at any rate. And, confidentially"—he lowered his voice out of earshot of Medford, who had gone to the other side—"confidentially, I am inclined to think the same. Of course——"

"I'm betting there's oil here," Jerry asserted. "True, you can't ever be positive. But I do know the limestone we're drilling now is the same stuff as the caprock that lay like a lid right on top of a fortune in oil in the other field. If I'm a good guesser, the gray slush we're bailing up now means Wilcox sand next. That may hold nothing but water, but then it may bring oil."

"Maybe so. Perhaps you're right. But the feeling among the stockholders is that there has been enough money spent. I'm afraid—I'm *afraid* we're going to have to shut down in a week or so, before we go as deep as we had intended."

"Really? Do you think so, Mr. Bolton?" Jerry asked.

(Continued on page 148)

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Jerry Smashes Through

(*Continued from page 147*)

"I'm *afraid* so. Disappointing, isn't it?"

"Damned disappointing!"

"Yes, I feel as you do. Inasmuch as we were making the attempt, I hoped we would be able to reach its completion."

He rose and turned to go, with a sorrowful shrug of his big shoulders. "I thought I'd tell you," he said. "If I were you, I wouldn't—that is—well, I don't think it would make much difference whether you did a little more or a little less the next few weeks. The way things appear now, it won't come to anything, anyway. When high speed is needed, I have a grateful appreciation for it, but I am the kind of man who doesn't believe in asking for unusual effort when it won't do any good. You understand?"

"Y-e-s," said Jerry slowly. "I understand, I think."

BUT the news of the impending shutdown did not slow his work. Rather it seemed to proceed more swiftly, with an almost desperate energy. The engine steamed and the bull-wheel whirled, winding the cable about it. Little sprays of mud shot off in the wind, as the line came up from the slush in the hole. The tools rose dripping and slick and were swung clear.

Medford brought the bailer from the side. The five-foot bucket dropped swiftly into the hole. Downward sped the sand line, almost a mile of it. A strip of cloth which Jerry had tied around it, marking the length, announced that the bailer was at the bottom.

When the whirring calf-wheel pulled it up and it was drawn aside to be emptied, Jerry bent close watch upon the muddy water sluicing out. All the pulped rock and earth, ground up by the bit, had to be brought up in that water. To his alert eyes, it was the story of the formations through which he was drilling. Pailfuls, saved from the outpourings of the bailer and left to settle, gave up dark gray silt. He rubbed it between his fingers, studying it intently.

The bit was pounding again. Some softer stratum yielded more easily now. The bailer brought up a slush of soft green shale. This was no common formation. Again Jerry compared his records. Sure enough, the same green shale had appeared at 5,000 feet in the field on the other side of Drumwell. Jerry grinned. The tools plunged deeper. There were briefer intervals between the turns to the temper screw, lowering the line below the walking-beam. The five feet of extension it allowed were let out quickly, and a new hold was taken on the cable, farther up. In a day they made thirty "screws"—a hundred and fifty feet of progress.

"SHUT us down, will they!" Jerry said through his teeth. "They'll have to hurry."

Medford laughed boyishly with excitement and pleasure.

"It won't be long now! We're going to know one way or the other. Anybody that wants to stop us will sure have to hustle."

* * *

In the parlor of his home in Oklahoma City, old Clarence Fittley sat talking with a stranger named Bleen. Fittley had retired to enjoy middle age after a score of years as a merchant in several oil towns, including Drumwell. Bleen's past and present were less obvious.

"What does it matter who I'm with?" Bleen demanded. "I want to buy the lease from you in my own name. I'm talking cash."

"But the Drumwell-National is drilling on it," Fittley replied. "Even if I wanted to, I couldn't sell it while they're drilling."

Bleen's lips moved a little to one side and downward as he laughed. "You ought to know more about oil leases than that. Listen here!" His harsh voice seemed

(*Continued on page 149*)

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Jerry Smashes Through

(Continued from page 148)

almost to be beating about Fittley's mild, graying head. "Go take a look at your lease. Do you think it's extended automatically, just because they're *drilling?* No! They've got to actually be producing *oil.*"

"Yes, I know that. But as long as they're working, I feel I oughtn't to take it away from them."

"Oh, you do! And if they get a dry hole, then where are you? I'm offering you a good price now. Do you expect me to let it stand if they don't get oil? Don't forget, there've been six wildcats in that neighborhood, before this one."

"Of course——"

"And what's more, suppose the Drumwell-National doesn't want to renew the lease?"

"Oh, they wouldn't let it go now."

"Wouldn't they? I don't know. Why don't you call them up on long distance, and see?"

"But I don't believe——"

Bleen had got up to go.

"YOU think it over," he commanded. "I'll be back tomorrow."

Next afternoon found him in the parlor again.

"Well, what do you think now?"

"I phoned Drumwell last night," Fittley said slowly.

"Yes? What did they say?"

"Mr. Bolton down there said they hope to complete the well before the lease is up."

"Expects to get a gusher, does he?"

"He didn't say that."

"Well, suppose they don't complete the well in time. Then what? Will they pay you for a new lease?"

"I gathered from Mr. Bolton that they're short of funds."

Fittley was shaking his head slowly, puzzledly. Bleen laughed his one-sided laugh.

"What are you going to do about it? Protect yourself?"

"I guess I'll have to. I can't afford to throw money away."

When the interview was concluded, the two men went together to a notary, and executed a new lease.

"Of course," said Fittley, "if they get oil, this is void. I'm dating it the twenty-fifth. The other lease lasts till then."

"O.K." said Bleen. "That's five days off."

* * *

AT THE rig the engine drove the bull-wheel fiercely, the wet cable streaked up out of the well, the steel drill-stem emerged, rose some thirty feet in the derrick, paused with the bit hung dripping over the hole, and was swung to the side. The bailer went down, came back brimming, and was quickly emptied. Part of the contents went into the bent pail on the floor.

In the motion of turning back to the hole, Jerry Crandall stopped abruptly. Off balance, he jerked back, dropping to one knee and eyeing the sludgy contents of the pail. His posture was tense.

"Phil, come here!"

He called the tool dresser without taking his eager gray eyes from the bucket. Medford came bounding.

"Look!" Jerry commanded.

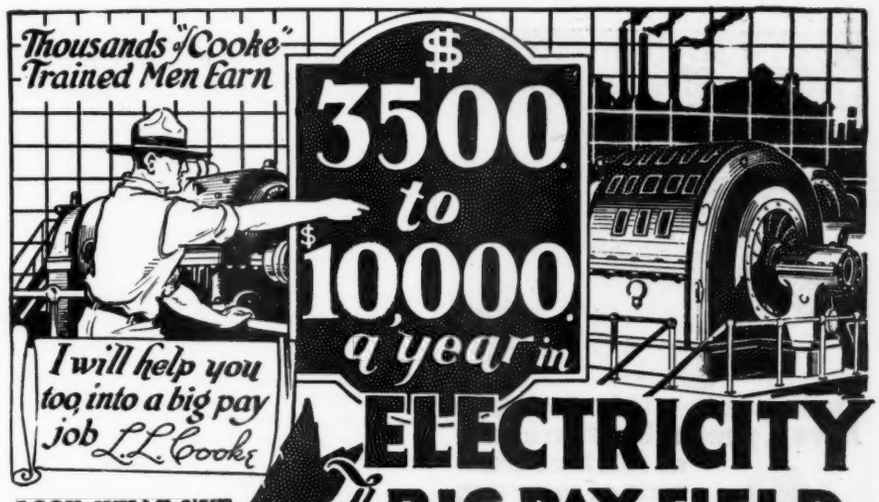
On top of the muddy water a thin film showed, faintly iridescent. It caught the light in elusive, changing colors, streaking and spiraling into fanciful patterns.

Medford bent down with his hands on his knees.

"Say!" he exclaimed. "*Say!*"

They set the pail aside and bailed again. The same thin film topped the water. Jerry went into the engine house and brought out a little can of silt, left there to dry, from the morning's bailing. He took a portion of it in his fingers.

(Continued on page 150)



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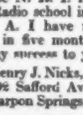

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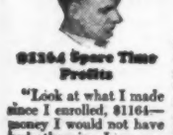

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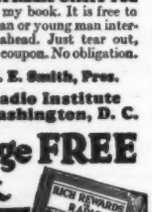

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Jerry Smashes Through

(*Continued from page 149*)

"Must be the Wilcox," said Medford.

"I wasn't sure," said Jerry, "but it must be."

He examined it minutely. Was it the Wilcox sand, the same formation of porous sandstone which had yielded the gushers to the south?

"We'll go a little deeper," he said at last. "About a screw. We'll see how it looks then."

Before they had gone half of the five feet, Jerry brought the bit up. A run of the bailer showed a foot of blackish oil topping the column of water at the bottom of the hole.

"It may not be anything," he declared, restraining his enthusiasm with visible effort. "There may not be enough there to pay for pumping, let alone drilling."

"Why not go ahead deeper?" the tool dresser urged. "Why not let's find out?"

THE bit was already partly into the mouth of the well, when Jerry paused. "No, wait," he said. "There's not a bit of storage here. If we go pounding around down there, it may blow in on us. No telling how much would be wasted before we could get the tanks up, and a line laid."

"That's right, too."

"I think we have it, now. I *think* we have." Jerry was exultant. "But there's no use being excited and going about it clumsily. If this is it, we have time enough to do it right."

In spite of themselves, the two men were beginning to give way to their glee. Medford did a jig-step on the derrick floor. Jerry's teeth showed white; he gripped the tool dresser's arm.

"Stay here while I go into town," he said. "I'm going to have them rush storage."

Jerry's car raced to town. When he returned he announced, "It'll take a week."

"A week?" Medford complained. "How are we ever going to wait a week?"

"Pretty hard, isn't it? But haste might make waste. It's lucky we didn't go ahead. A lot of oil could be lost in a week. Of course—we may not get it after all. This may be just a pocket." He bit his lip at the thought. "I'm pretty confident, though. I stopped by—to tell Bolton. He wasn't there. I left word for him to come out."

THE vice president came in a car with another man. Medford saw them in the distance.

"Who's the fellow with him?" he asked.

"I don't know. Better be careful what we say. It may not matter. But I'll get Mr. Bolton by himself and tell him."

"Doesn't he know?"

"Not yet. I didn't tell them at the office. We'll go on just as if we were drilling. Then if Mr. Bolton wants to let the other fellow in on the news, he has the authority to do it."

The two men were climbing out of the car. Bolton came somewhat in advance of the other, who remained a short distance from the rig, surveying it contemplatively.

"Hello there!" exclaimed the vice president, in his rich, strong voice. "How are things going?"

"Pretty well," Jerry announced.

The stranger was nosing about the rig, gazing into the little ditch which had carried away the water bailed from the well. Traces of oil remained. With a loud call to Medford, Jerry had the bit started into the well. It would help to allay the stranger's suspicion.

Holding tightly to the brake-lever which regulated the speed of the descending tools, Jerry beckoned to the vice president.

"Mr. Bolton. Please."

Bolton came up to him.

"I thought I'd better call you," said Jerry.

"Yes? Anything special?"

"Well—we have quite a showing."

Bolton glanced toward the stranger, who was out of earshot.

"Is it—ah, imminent, this showing of oil?"

"It looks pretty good."

The vice president crossed his arms over his huge, plump chest and eyed Jerry keenly.

"Young man," he said, "I've got something interesting I wish to talk to you about."

"Yes?"

Jerry was reserved. The details of his own news could wait. Holding to the brake-lever, he was attentive to Bolton.

"You're a clever young man, with brains," the vice president began. "You've shown that your worth is mighty valuable to anyone who really knows how to appreciate brains."

"Thanks."

"YOU could earn yourself a great amount of money if you so desired." Bolton laid a friendly hand on Jerry's shoulder, and lowered his voice almost to a whisper. "These hick stockholders back East never did appreciate the gigantic problems that confronted us practical oil men. Now they are so tight that they not only don't wish to pay a young man like you what you are entitled to, but they even won't put up the money that is required to renew this lease. It would serve them right if they lost it."

Jerry did not reply. He was gazing steadily at the vice president, almost without expression in his cool gray eyes.

Bolton beckoned the stranger to come.

"I want you to meet a friend of mine. This is Mr. Bleen. Mr. Crandall."

They shook hands gingerly. Bleen watched Jerry's face sharply.

"Now see here," Bolton whispered, "the company's lease expires in——"

"In the near future," Bleen interrupted. He had not taken his eyes from Jerry's face. Something he saw there seemed unsatisfactory. "A lease doesn't last forever," he added vaguely.

"The lease expires in the near future." The vice president had accepted Bleen's wording. "Now a group of men who do not squeeze a dollar so penuriously have arranged to take it over after its expiration. They would be glad to give you a mighty profitable share if you will just coöperate with them."

STILL Jerry did not reply. His face had taken on a steel-like hardness. Bolton seemed not to notice it.

"The only thing for you to do," he continued, "is just not to say anything about the condition of the well here, and—and—ah, not proceed very fast for the next—"

"For awhile," Bleen interrupted.

"That's it," said Bolton. "Just don't proceed very fast for awhile."

Jerry spoke only two words.

"Get out!"

Bolton flushed and gaped.

"Apparently," he said, "you don't seem to understand."

"I do," the driller snapped. "Listen. I understand some things now that I only suspected before. I wasn't sure you were back of Buck Norden when he lost those tools."

"Why—why, my dear young man—an accident—"

"Accident? When we fished them out, the piece of cable on the end showed what kind of an accident it was. That cable wasn't broken. It was filed!"

"Look here, young fellow!" Bolton's manner had suddenly lost its honey. His face was crimson. He began to bluster. "You can't stand here and say——"

"Get out!" Jerry ordered.

Bleen shrugged his shoulders slightly and pulled at Bolton's arm.

"Come on. What's the use?" The two men stood arguing near the auto.

Jerry's eyes gleamed with further recognition. For the car in

(*Continued on page 151*)

Jerry Smashes Through

(*Continued from page 150*)

the road had the outlines of the coupe which had stood there briefly on that night when he had slept at the well.

Bleen was urging Bolton to leave the place. He threw his coat back, showing a folded paper in an inner pocket, and laughed his queer, one-sided laugh. What was the need of further argument? The lease would be theirs in three days. The driller did not suspect. The well would not be producing oil before that time.

But Bolton would not yield. Jerry's words about the filed cable had been disturbing. He came back, with a new strategy.

"Look here now, young man. I've always liked you." The old syrup was back in his voice. "You know, you've made some pretty serious remarks." He put his hand out toward the driller's arm. "I wish——"

"You see that cable?" Red anger flamed beneath Jerry's tan. He flung his finger toward the line descending into the well. "There's a strip of cloth around it marking a mile. When that cloth shows up, you'd better be gone from here, if you love your hide!"

The vice president glanced at the cable. It was speeding faster.

"See here, young fellow——"

He backed away. Jerry followed. Bolton turned and broke into a run. He jumped into the coupe, after Bleen.

"Hey! Look! Jerry! Look!"

Medford was yelling excitedly. He ducked under a timber of the derrick, jumped to the ground outside, and ran, looking back over his shoulder, and shouting.

"Look! Jerry!"

FOLLOWING Bolton in his anger, Jerry had let go the brake lever. The tools had gone smashing to the bottom of the hole. It was all that was needed.

There was a rumbling. A roar. A black column of liquid shot up, thundering like a suddenly freed Niagara. There was a crash, the sound of splintering wood, and the steel tools tore through the derrick timbers, a three-ton bullet shot through a mile-long gun.

Jerry stared, wide-eyed, as if stunned by the suddenness of the thing. Off to the side, Medford gaped for a moment, then leaped into the air, turned a handspring, and came dashing toward Jerry.

Medford clutched at Jerry's arms and shook him. In a moment the driller's tenseness snapped as he flung his own hat madly into the air and joined the tool-dresser in his antics of glee. They shook each other's hands, danced in a crazy circle, and let go their hoarse voices in unheard cheers.

From Main and Broadway, Drumwell, you could see the gusher, spouting out over the crown-block, giving off a feathery spray in the wind, a great black plume of oil announcing the discovery of a new pool and new millions in wealth, signaling the triumph of a driller who wouldn't be stopped.

Bolton and Bleen sat dejectedly in the office that night.

"I guess I'm done for with the Drumwell-National," said the vice president.

Bleen gave no sign of hearing. He took a folded paper from his pocket and crumpled it viciously, mumbling to himself.

"If they'd just been three days later!"

At the rig, Jerry was frowning, while a work crew plied picks and shovels throwing up earth embankments to hold the lake of oil till pipe-lines and tanks could be completed.

"I could kick myself!" he complained to Medford. "I shouldn't have lost my temper. Then we wouldn't have had this makeshift work." The pinch of conscience showed in his bright gray eyes. "We'd have saved the company this money, if I'd waited just a week to bring it in!"

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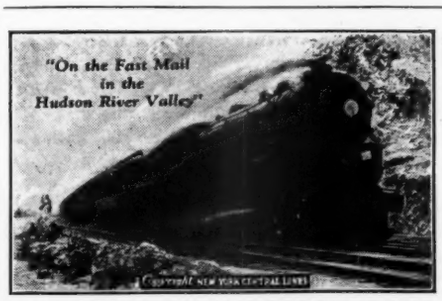

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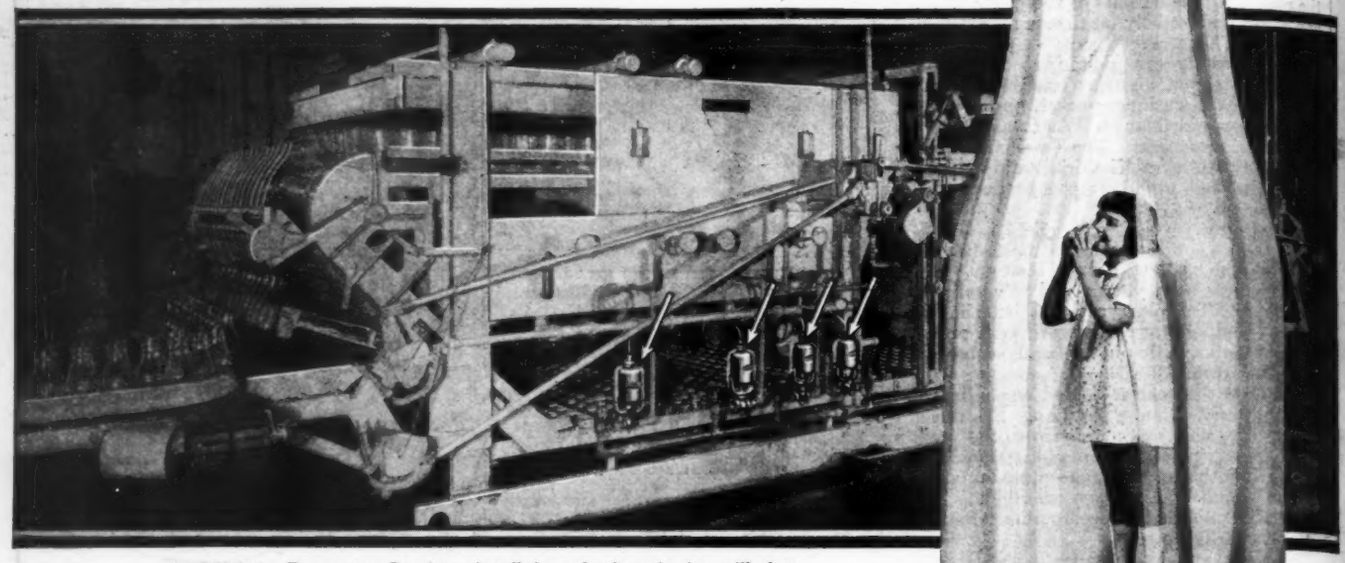

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